MULTI-CHANNEL COMBINER DESIGNS for SHARED DTV ANTENNA SITES

Presented By

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DISCUSSIONS

1. Introduction
2. Design requirements
   - What to look for
3. Design Characteristics
4. Common combiner designs
5. Examples of combiners in use
6. System configurations
   - The good and the not so good

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INTRODUCTION

- Multi-channel combiners are used to sum various inputs with different frequencies into a single output to feed a wideband antenna
- Proper design will provide the best transmission path for the DTV signal

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- DESIGN REQUIREMENTS -

- Must be able to handle the sum of all input powers
- Peak Power and heating need to be evaluated
- Low VSWR
- Insertion loss – the lower the better
  - Less heat
  - Higher efficiency
- High Isolation
  - reduce the chances of intermod products

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- DESIGN CHARACTERISTICS -

A) SELECTIVITY

- Bandpass filter designs will determine channel spacing and isolation
  - 4 pole = 2 or more channel spacing (ex: CH 24,27,30)
  - 6 pole = 1 or more channels spacing (ex: CH 24,26,28)
  - 8 pole = adjacent channels (ex: CH 24,25,26)

B) POWER HANDLING

- Must be capable of accepting the required power of each transmitter with minimum loss.
- Advisable to include a safety factor for mean power and voltage (typically 1.5)
- Should present a reasonably well-matched impedance to each transmitter.
- Typical values for each input are a VSWR of 1.10:1 or less.

C) ISOLATION

- Should provide for high isolation between inputs
  - Typical minimum isolation is 36dB or more to help avoid creation of intermod freqeuncies

D) INSERTION LOSS

- the lower the better for minimal heating and best efficiency
- filter selectivity has most impact on loss (large filters = lower losses)

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COMMON DESIGNS

- Starpoint (or junction)
- Manifold
- Constant impedance

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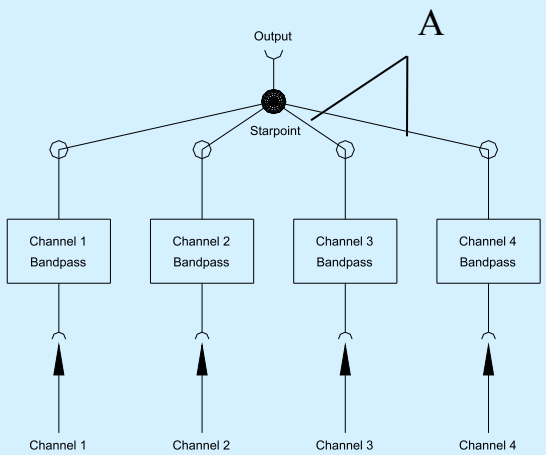
STARPOINT/JUNCTION



- Multiple filters with a common junction
- Complex phasing of interconnecting lines is required to properly combine the channels
- Phasing of lines (A) is critical
- Not practical for combining many channels due to line phasing concerns and reduced performance.
- Typically used for up to 4 inputs.
- Not expandable in the future
- Good choice for low to medium input powers
- Low cost solution

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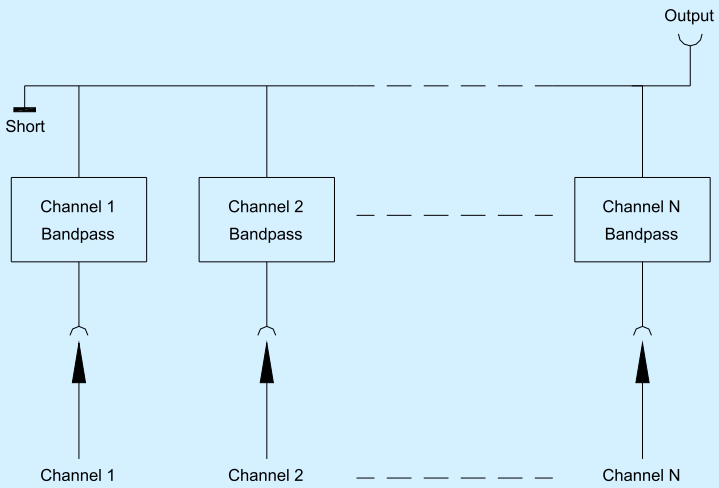
MANIFOLD



- Multiple filters connected in parallel to a common output line
- Phasing of interconnecting lines less complex than the starpoint
- Used to combine more than 4 inputs (up to 8)
- Good for low to medium powers
- Low cost solution

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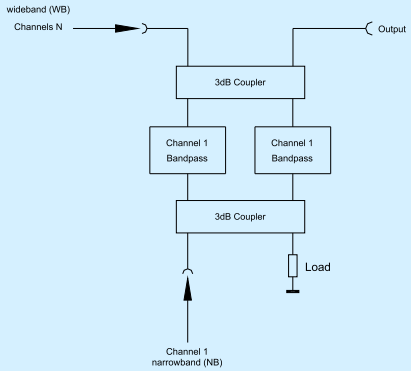
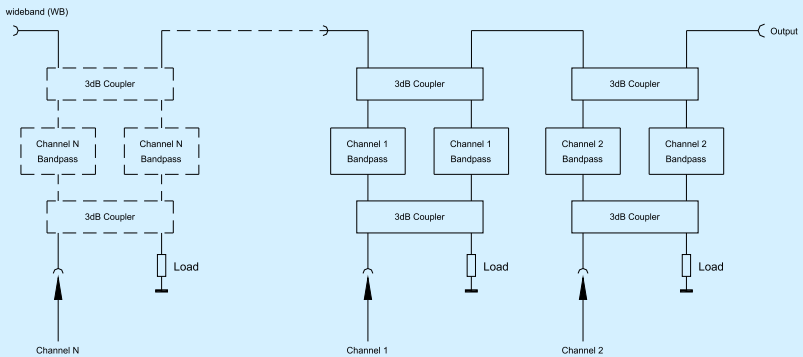
CONSTANT IMPEDANCE



Single Module



Multi-channel

- Balanced structure
- Two identical filters
- Two hybrid couplers (3dB hybrids)
- NB (narrowband) input (filtered input)
- WB (wideband) input
- Suitable for adjacent channels
- Expandable in the future
- Ideal for medium to high input powers
- Higher cost but versatile

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SUMMARY
COMBINER TYPES

STARPOINT

- Cost $-$$$
- Compact Size
- Low-Medium Powers
- Fixed Channels
- Non-Adjacent
- Not expandable
- Good for 2,3 or 4 Channels

MANIFOLD

- Cost $-$$$
- Compact Size
- Low-Med-High Powers
- Fixed Channels
- Non-Adjacent
- Not expandable
- Good to 8 Channels

CONSTANT IMPEDANCE

- Cost $$$-$$$$$
- Size based on powers
- Med-High Powers
- Adjacent Channels
- Expandable
- Good for many channels

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VHF
MULTI-CHANNEL COMBINER

EXAMPLES

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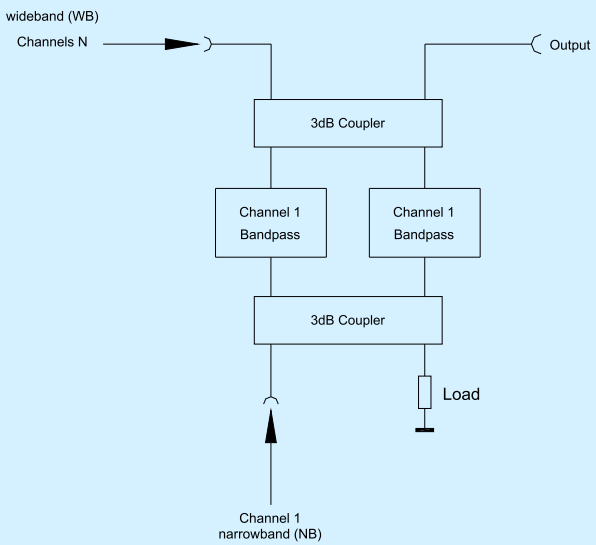
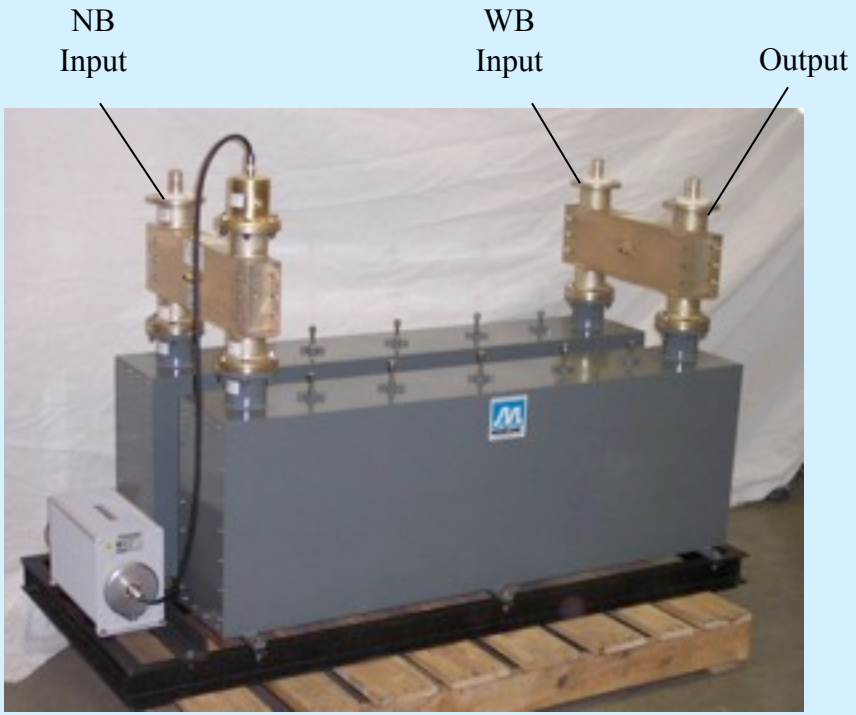
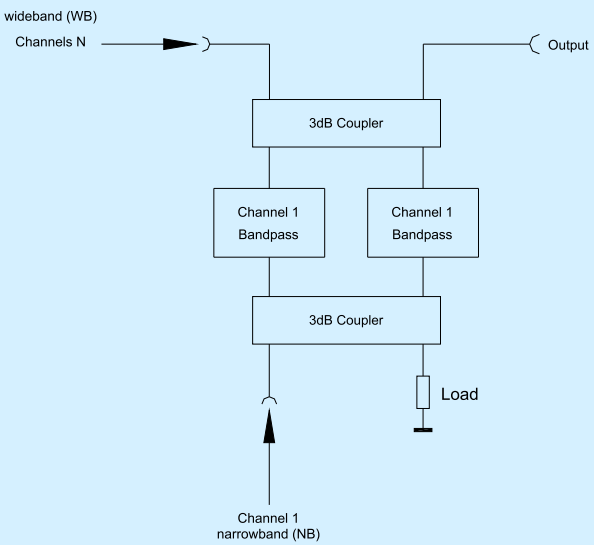
Constant Impedance Module for CH's 7-13





Constant Impedance Adjacent Channel Combiner CH 7/8 with patch panel



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UHF
MULTI-CHANNEL COMBINER

EXAMPLES

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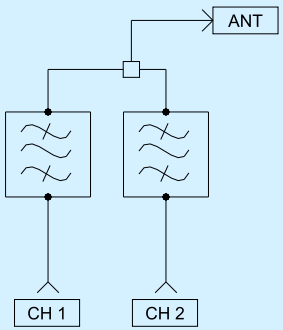
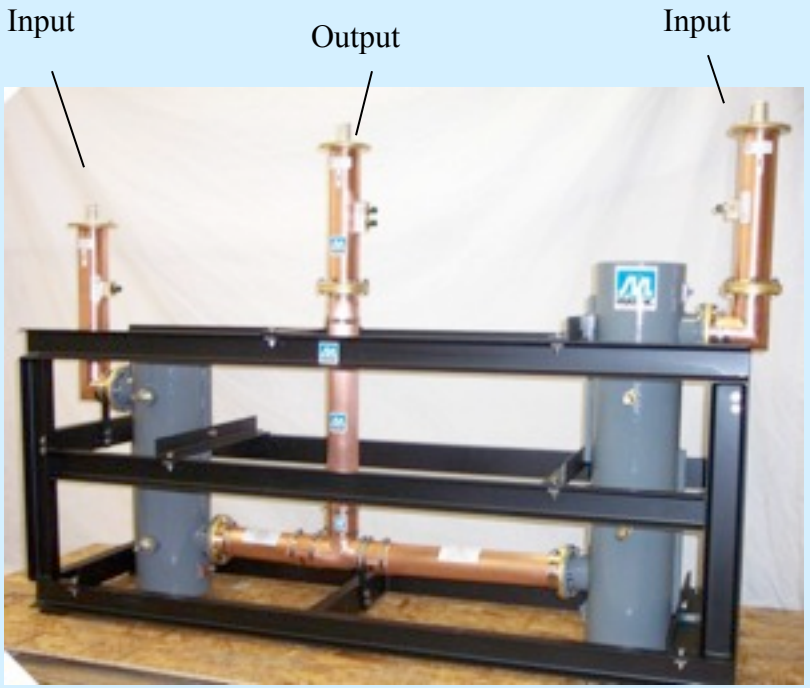
STAR POINT
UHF

- TWO CHANNEL
- WIDE SPACING
- 2 x 5kW





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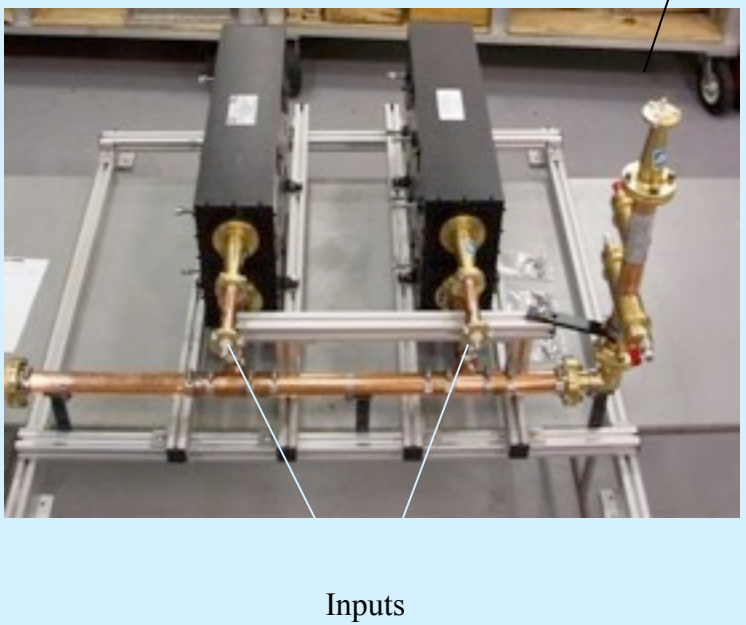
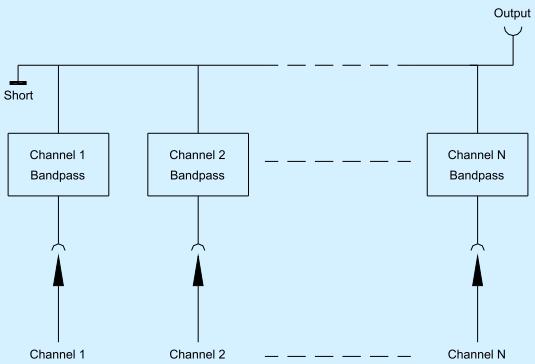
MANIFOLD
UHF

- TWO CHANNEL
- 2 X 2kW INPUTS
- 1 CHANNEL SPACING
- COMPACT SIZE



MANIFOLD
UHF

- FOUR CHANNEL
- 4 X 5KW INPUTS
- COMPACT SIZE



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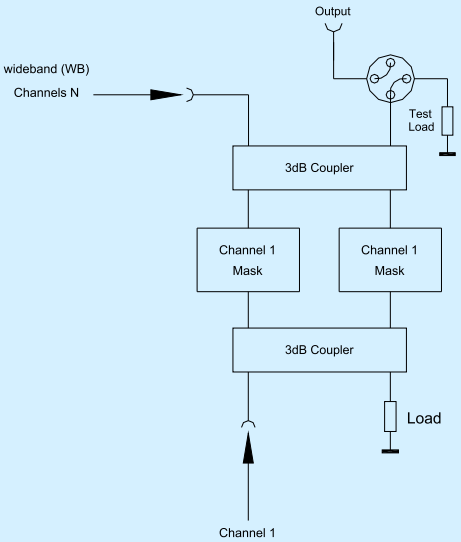
Constant Impedance Module
UHF

- MASK FILTER 10kW
- PATCH PANEL FOR TEST
- MONITOR POINTS FOR MASK PRE-CORRECTION



CONSTANT IMPEDANCE
Compact Design
UHF

- Best for medium to high powers
- Minimal floor space
- Adjacent and non-adjacent channels
- Easily expandable

Ten Channel High Power
Combiner from RFS

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Basic System Configurations

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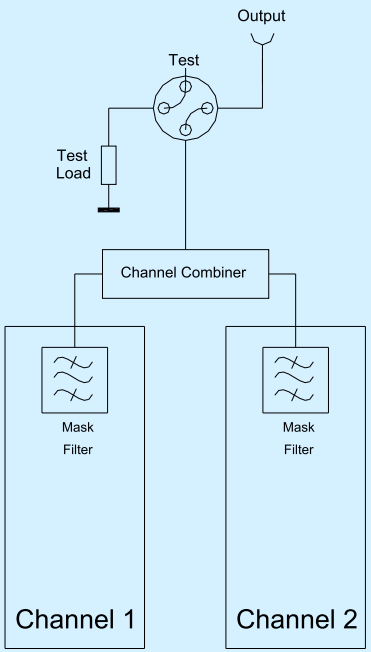
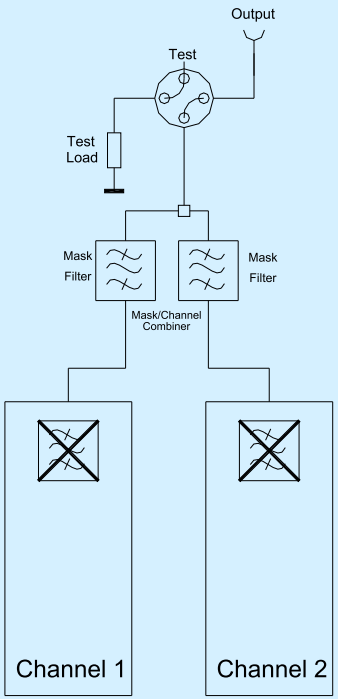
CONFIGURATION A



- Basic channel combiner set-up
- Mask filter provided with the transmitter
- Monitoring of DTV signal is done before combiner for pre-correction
- Combiner effects on DTV signal can be added to pre-correction
- Output switch allows:
  - Stations to test into load
  - Ant/line test without combiner in circuit
  - Test load performance
- Stations MUST go Off Air to test any one station into the test load
- Not a good set up

Note: 4th port on switch/patch panel can also be used for back up transmitter

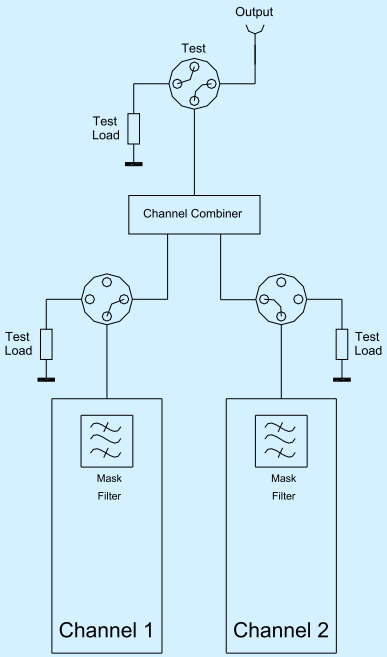
CONFIGURATION B



- Mask Filter integrated into channel combiner design
- Difficulty in monitoring DTV signal through mask/combiner to allow for pre-correction
- Output switch allows:
  - Stations to test into load
  - Ant/line test without combiner
  - Test load performance
- Stations MUST go Off Air to test any transmitter into the test load
- Not a good set up

Note: 4th port on switch/patch panel can also be used for back up transmitter

CONFIGURATION C



- Mask filter provided with the transmitter
- Monitoring of DTV signal done before combiner for pre-correction
- Switch on combiner input allows individual transmitter testing into load
- Switch on channel combiner output allows:
  - Tx test into test load
  - Ant/line test without combiner
  - Test performance of load
- Stations can run individual tests into load without bothering the other channel(s)
- No Off Air time for other channel(s) when testing
- Best set up

Note: 4th port on switch/patch panel can also be used for back up transmitter

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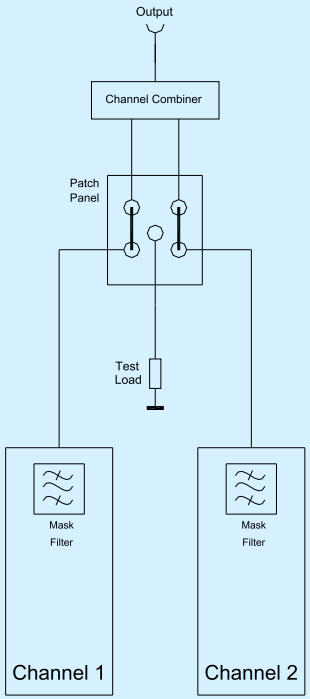
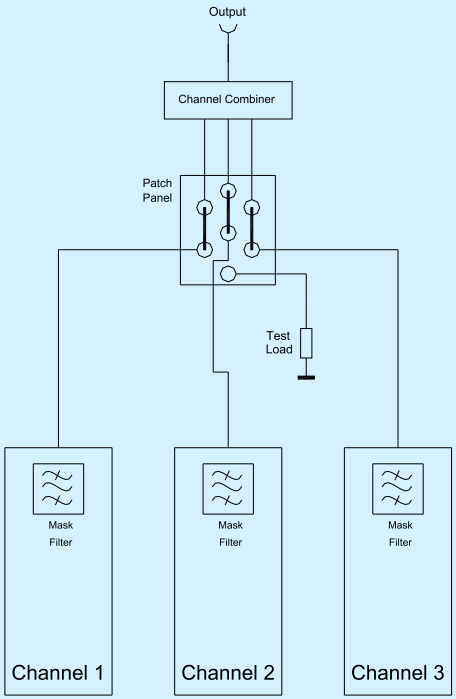
CONFIGURATION D



- Mask filter provided with the transmitter
- Monitoring of DTV signal done before combiner for pre-correction
- Patch Panel on combiner input allows:
  - Station test into comon test load
- Stations can run individual tests into load without bothering the other channel
- No Off Air time for other channel(s) when testing
- Good set up

CONFIGURATION E



- Mask filter provided with the transmitter
- Monitoring of DTV signal done before combiner for pre-correction
- Patch Panel on combiner input allows:
  - Station testing into common test load
- Stations can run individual tests into load without bothering the other channels
- No Off Air time for other channels when testing
- Good set up

MULTI-CHANNEL SYSTEMS SUMMARY

1. DTV mask filters should be a stand alone entity so that proper signal sampling can be used to provide the best possible DTV signal after pre-correction
2. Test points (switches/patch panels) need to be provided so that any performance issues can be isolated and resolved
3. Effects of combiner performance on DTV signal can be provided by the manufacturer and integrated into the pre-correction calculations. These are usually minimal except where there are adjacent channels.
4. Proper pre-planning will provide optimum performance of the DTV signal

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THANK YOU

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