

HEXDF® DOCUMENTATION SUITE

HexDF® Whitepaper

Modular direction-finding antenna and RF frontend platform

SOMETHING NEW IS COMING...

HexDF

S E R I E S

NEXT GENERATION DIRECTION FINDING PLATFORM

0.5 GHz – 42 GHz
TOTAL FREQUENCY COVERAGE

 **MODULAR**
FRONTENDS

 **SCALABLE**
SOLUTIONS

 **BROADBAND**
PERFORMANCE



SYSTEM ARCHITECTURE & INTEGRATION BY MMT
POWERED BY STEATITE ANTENNA MODULES

 **mmt**
gmbh

 **Steatite**

Modular. Scalable. Broadband.

Direction-finding antenna platforms from 0.5 to 42 GHz with selectable RF switch, LNA, converter, RF over Fiber and optional omnidirectional monitoring channel.

Executive summary

A configurable family of six-sector direction-finding frontends built around defined antenna modules

HexDF® combines radial antenna sectors, configurable RF conditioning, calibration and receiver i

1

Nine frontends

0.5 GHz to 42 GHz total antenna capability across the family.

2

Single- and dual-ring

Six sectors per frequency ring; dual-ring variants segment low/mid and high bands.

3

Defined module basis

Real Steatite QMS modules with documented dimensions, mass, connector and beamwidth.

4

360° detection concept

Six overlapping sector responses with max-channel or multi-channel DF processing.

5

Preliminary system data

Installed patterns, accuracy and environmental performance require final integration and validation.

Engineering boundary

Steatite test reports describe the individual antenna modules. HexDF system performance also depends on installed geometry, RF core, switching or channel architecture, radome, cable routing, calibration and the selected DF algorithm.

Product family

Corrected baseline antenna combinations and system positioning

Model	System band	Baseline module set	Architecture	Primary positioning
HexDF-08W	0.5-8 GHz	QMS-00767	Single ring	Low-band monitoring
HexDF-08	1-8 GHz	QMS-00457 / 00458	Single ring	Mobile DF / UAV
HexDF-18	1-18 GHz	QMS-00761 / 00762	Single ring	Universal DF
HexDF-18C	2-18 GHz	QMS-00769 / 00309	Single ring	Compact / low SWaP
HexDF-22	0.5-22 GHz	QMS-00315 / 00314	Single ring	Extended wideband
HexDF-40E	0.5-40 GHz*	00315/314 + 00961/962	Dual ring	Maximum low-band reach
HexDF-40	1-40 GHz*	00761/762 + 00961/962	Dual ring	Broad 1-40 GHz
HexDF-40C	2-40 GHz	QMS-00934 / 00933	Single ring	Compact direct wideband
HexDF-42	6-42 GHz	QMS-00992 + 00962	Dual ring	Microwave / mmWave

Naming versus antenna capability

HexDF-40 and HexDF-40E use high-band modules capable to 42 GHz. The published system limit may remain 40 GHz through filtering, conversion or receiver definition. The asterisk marks this distinction.

Selected antenna module families I

1-18 GHz, 2-18 GHz and direct-wideband modules

1-18 GHz main ring

QMS-00761 / QMS-00762

Ø78 × 48 mm · 170 g each



0.5-22 GHz wide ring

QMS-00315 / QMS-00314

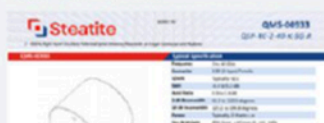
Ø151.4 × 117 mm · 600 g each



2-40 GHz direct ring

QMS-00934 / QMS-00933

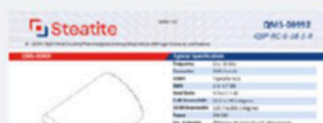
Ø50.5 × 45 mm · 140 g each



6-18 GHz compact ring

QMS-00992

Ø30 × 49.5 mm · 48 g each



Selected antenna module families II

Low-band and 18-42 GHz high-band modules



18-42 GHz high band

QMS-00961 / QMS-00962

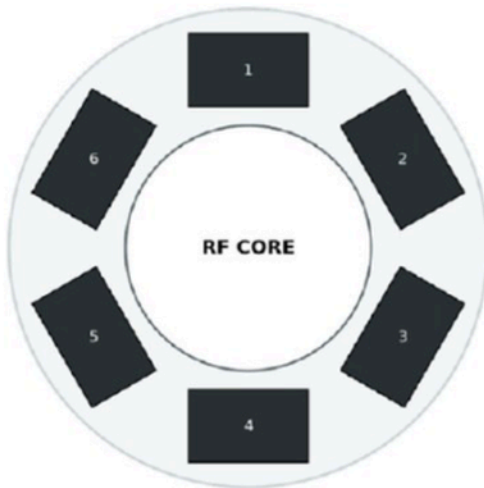
Ø20 x 45 mm · 26 g each



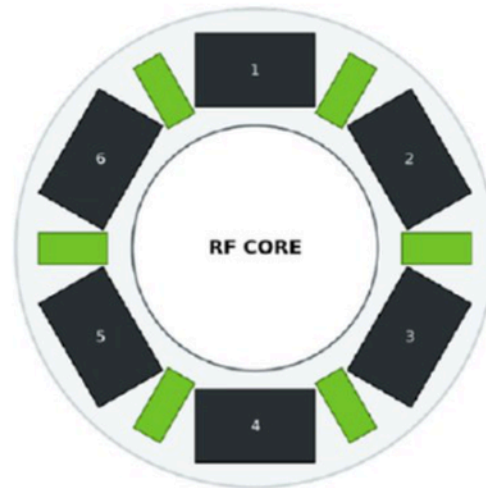
Mechanical integration

Top-view architectures with real module proportions

Single ring: 6 × Ø78 mm modules



Dual ring: 6 × Ø78 mm + 6 × Ø20 mm



Model	Antenna geometry	Module mass	Indicative system Ø*
HexDF-08	6 × Ø68 × 47.8 mm	0.90 kg	≈ 284 mm
HexDF-18	6 × Ø78 × 48 mm	1.02 kg	≈ 287 mm
HexDF-18C light	6 × Ø70 × 43 mm	0.66 kg	≈ 279 mm
HexDF-22 light	6 × Ø151.4 × 117 mm	3.60 kg	≈ 520 mm
HexDF-40	6 × Ø78 + 6 × Ø20 mm	1.176 kg	≈ 287 mm
HexDF-40C	6 × Ø50.5 × 45 mm	0.84 kg	≈ 275 mm
HexDF-42 compact	6 × Ø30 + 6 × Ø20 mm	0.444 kg	≈ 281 mm

* First-order sizing with an indicative Ø160 mm RF core and integration clearances. Final diameter depends on connector routing, electronics, support structure and other factors.

Corrected antenna combinations

Frequency union, overlap and module-mass calculation

Model	Module combination	Antenna capability	Antenna-module mass
HexDF-18	6 × QMS-00761/762	1-18 GHz	$6 \times 0.170 = 1.020 \text{ kg}$
HexDF-18C light	6 × QMS-00769/00309	2-18 GHz	$6 \times 0.110 = 0.660 \text{ kg}$
HexDF-22 light	6 × QMS-00315/314	0.5-22 GHz	$6 \times 0.600 = 3.600 \text{ kg}$
HexDF-40E	6 × 00315/314 + 6 × 00961/962	0.5-42 GHz hardware	$3.600 + 0.156 = 3.756 \text{ kg}$
HexDF-40	6 × 00761/762 + 6 × 00961/962	1-42 GHz hardware	$1.020 + 0.156 = 1.176 \text{ kg}$
HexDF-40C	6 × QMS-00934/933	2-40 GHz	$6 \times 0.140 = 0.840 \text{ kg}$
HexDF-42	6 × QMS-00992 + 6 × QMS-00962	6-42 GHz	$0.288 + 0.156 = 0.444 \text{ kg}$

Polarization rule

All six sectors in one ring use one consistent polarization. Where both variants are available, the ring is ordered as complete RHCP or complete LHCP. HexDF-42 is currently documented as an RHCP baseline because the supplied QMS-00992 and QMS-00962 reports are RHCP.

Mass scope

Values above include antenna modules only. They exclude cable assemblies, RF switching or receivers, mounting structure, thermal hardware, external radome and connectors.

RF architecture and band segmentation

Antenna selection determines the front-end RF path per sector or band



Single-ring examples

HexDF-18: one 1-18 GHz path per sector.
 HexDF-22: one 0.5-22 GHz path per sector.
 HexDF-40C: one direct 2-40 GHz path per sector.

Dual-ring examples

HexDF-40E: 0.5-22 GHz plus 18-42 GHz.
 HexDF-40: 1-18 GHz plus 18-42 GHz.
 HexDF-42: 6-18 GHz plus 18-42 GHz.

Configurable RF and system options

● Limiter / protection

● LNA or switchable gain

● Preselector / notch filters

● Calibration injection

● RF switching or channelized receiver

● Downconversion / IF output

● GPSDO / OCXO / PPS / 10 MHz

● Ethernet / fiber / CAN / RS422

● Web GUI / API / SNMP / BIT

Core RF options and extensions

Initial scope: RF switching, low-noise amplification, frequency conversion and RF over Fiber

RF SWITCH



**6:1 sector selection for a single ring;
dual 6:1 or combined matrix for
dual-band systems**

Selects the active sector and supports
sequential or receiver-controlled
scanning.

LNA



**Shared LNA after the switch or
distributed LNA per sector**

Improves sensitivity; distributed LNAs
minimize pre-amplifier feeder and switch
loss.

CONVERTER



**Optional block downconverter with RF
bypass and defined IF output**

Connects wideband HexDF arrays to
receivers that cannot directly process the
full RF range.

RF OVER FIBER



**Optical transmitter and receiver for RF
or IF transport**

Enables remote mast, maritime and
distributed installations with low cable
loss and galvanic isolation.

Configuration rule

The four extensions are selected independently according to receiver architecture, sensitivity, operating frequency, dynamic range and installation distance. Other electronics are deliberately not shown in this first option set.

Optional omnidirectional monitoring channel I

Detection, trigger and reference architecture

Continuous 360° activity detection, triggering and reference monitoring alongside the six-sector DF array

OMNI-ASSISTED DF



- 1 Omni detects activity
- ↓
- 2 Controller starts sector scan
- ↓
- 3 Switch samples six sectors
- ↓
- 4 DF processor estimates bearing

Mechanical Integration

Preferred concept: central or slightly elevated Omni antenna above the RF core. A separate mast or offset mount remains an option when blockage, mutual coupling or high-frequency shadowing is critical.

Steatite option	Frequency	Pol.	Gain	Connector	Suggested HexDF role

Optional omnidirectional monitoring channel II

Representative Steatite omni candidates

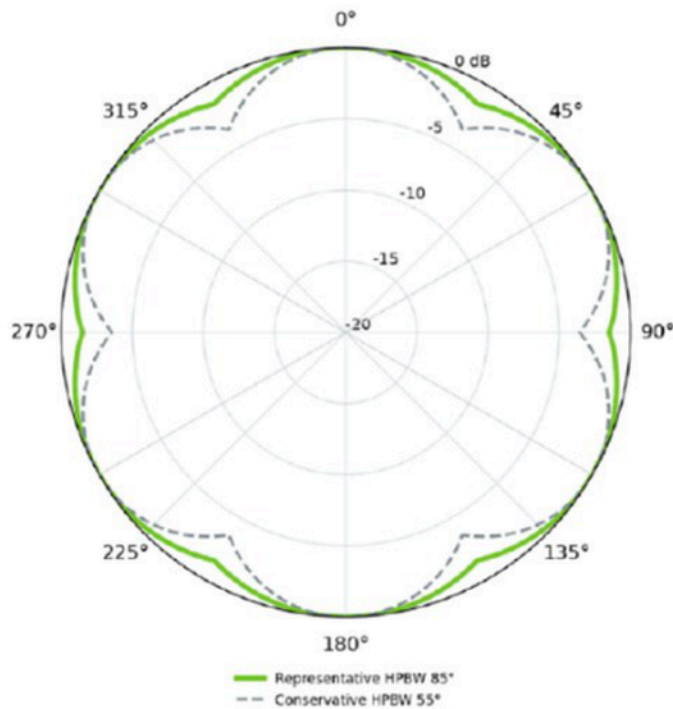
Steatite option	Frequency	Pol.	Gain	Connector	Suggested HexDF role
QMS-00347 / QMS-00017	0.8-40 GHz	Vertical	-2.2 to 6.9 / 5.9 dBi	K type	Ultra-wideband monitoring for HexDF-40 / 40C
QMS-01189	0.9-20 GHz	Vertical	0 to 6.3 dBi	SMA	Low-/mid-band trigger for HexDF-18 / 18C / 22
QMS-00929	6-18 GHz	Vertical	3.7 to 9.5 dBi	SMA	Compact mid-band reference for HexDF-42
QMS-01018	23-42.5 GHz	Vertical	4.2 to 6.4 dBi	K type	High-band / Ka-band trigger for HexDF-42

Source: Steatite Antennas public Omnidirectional Antennas product page. The Omni antenna is an optional monitoring/reference channel and does not replace the six DF sector antennas. Final placement requires EM simulation and installed-pattern verification.

Azimuth coverage of the complete array

Six overlapping sectors form a 360° max-channel envelope

Representative 360° max-channel coverage



Interpretation

- Boresights at 0°, 60°, 120°, 180°, 240° and 300°.
- The green curve is the maximum response of the six sector channels, not a coherent phased-array sum.
- Sector transitions occur halfway between adjacent boresights at $\pm 30^\circ$.
- If installed HPBW is $\geq 60^\circ$, the transition is approximately -3 dB or better.
- Narrower cuts can create scallops while still providing broader 10 dB detection overlap.

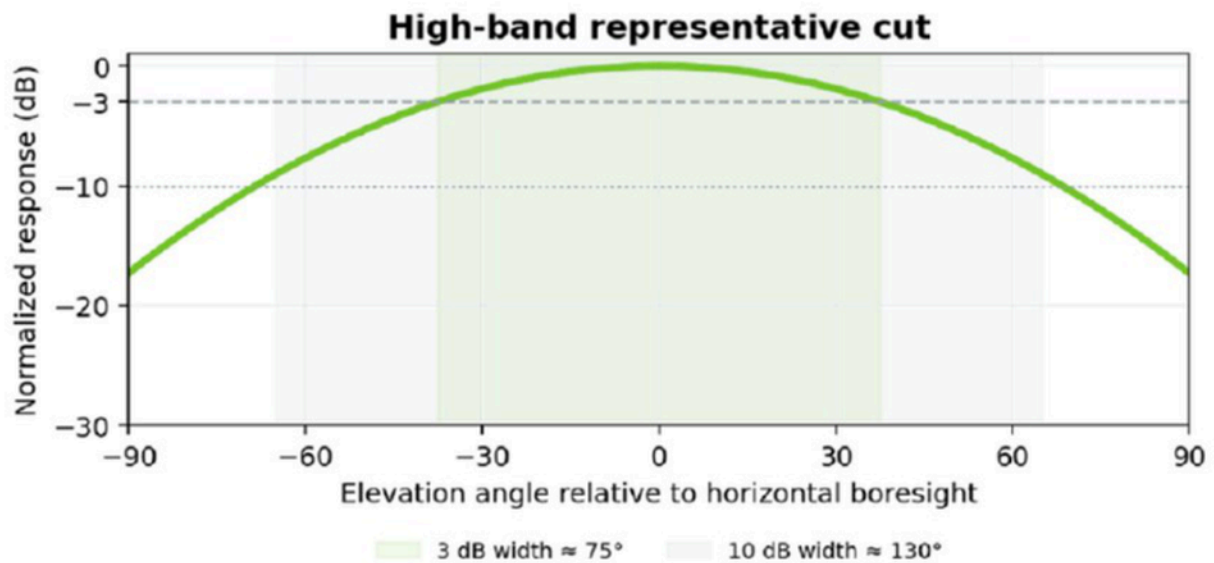
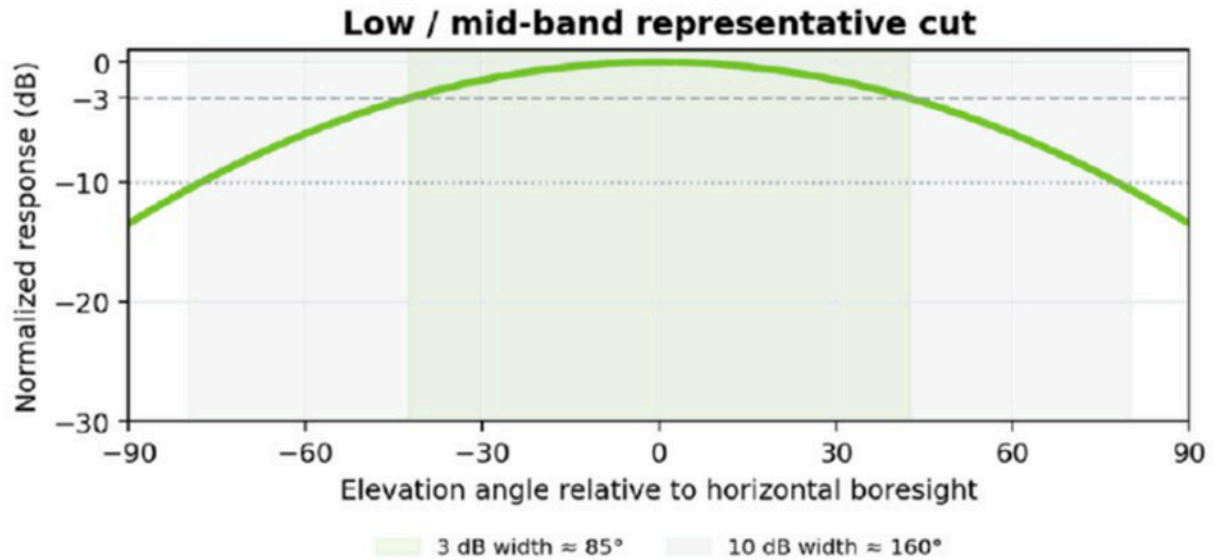
Illustrative single-sector HPBW	Approx. level at $\pm 30^\circ$ transition
HPBW 120°	≈ -0.8 dB
HPBW 90°	≈ -1.3 dB
HPBW 60°	≈ -3.0 dB
HPBW 51°	≈ -4.2 dB
HPBW 27°	≈ -14.8 dB

Recommended development target

For robust amplitude comparison between adjacent sectors, target an installed azimuth HPBW of roughly 70-100° over the primary operating range. Final values require installed-element simulation and chamber measurement with the complete housing and radome.

Representative elevation cuts

Normalized single-sector cuts referenced to horizontal boresight



Limitations

These are explanatory curves derived from documented beamwidth ranges. They are not measured installed cuts. The final elevation response depends on module clocking, support structure, RF core blockage, platform height, radome and nearby vehicle or mast structures.

Calibration and DF processing

Repeatable direction finding requires channel matching and installed-pattern knowledge

1

Channel equalization

Measure amplitude and phase tracking across cables, switches, filters, gain states and receivers.

2

Calibration injection

Provide a stable reference path for production, maintenance and built-in test.

3

Installed pattern set

Characterize each sector versus frequency, azimuth, elevation and polarization.

4

DF algorithm

Apply amplitude comparison, Watson-Watt, correlative DF or multi-channel processing as appropriate.

5

Validation

Quantify sensitivity, sector handover, ambiguity, bearing accuracy and environmental stability.

Processing architecture

HexDF can support switched single-receiver configurations or simultaneous multi-channel receiver architectures. The latter offers faster updates and richer phase/amplitude information but increases receiver count, calibration complexity and data bandwidth.

Applications and configuration rules

Select the model from mission, frequency, deployment and processing requirements

COMINT / SIGINT

HexDF-08W, -08, -18 and -22 for communications intercept, monitoring and emitter localization.

ELINT / radar

HexDF-40, -40C and -42 for microwave and millimetre-wave observation.

Counter-UAS

HexDF-08, -18 and -18C for RF detection, sector cueing and localization.

Spectrum monitoring

HexDF-08W, -22 and -40E where low-frequency reach and wide coverage are important.

Vehicle / UAV

HexDF-18C, -40C and compact HexDF-42 architectures for low-SWaP integration.

Fixed / maritime

HexDF-22 and -40E where larger apertures and rugged options are acceptable.

Configuration inputs

- Target frequency range and required polarization
- Receiver architecture and instantaneous bandwidth
- Mechanical envelope, mass and power
- Platform and radome environment
- Calibration concept and DF method
- Temperature, vibration, shock, ingress and altitude

Development and qualification roadmap

From selected modules to a verified HexDF product

1

Freeze module set

Confirm LHCP/RHCP, exact QMS references and system operating band.

2

Mechanical integration

Finalize sector radius, support structure, cable routing, thermal concept and radome.

3

RF chain definition

Select protection, gain, filtering, switching, conversion, receiver and calibration functions.

4

Prototype and characterize

Measure installed patterns, coupling, channel tracking, thermal behaviour and RF performance.

5

Qualify and release

Validate environmental, EMC, interface, production and lifecycle requirements.

Discuss the required HexDF® configuration

mmt gmbh | Meffert Microwave Technology

info@meffert-mt.de | www.meffert-mt.de | +49 6435 303 9020

Technical assumptions and source hierarchy

How to interpret module data, architecture and pattern estimates

Primary source

Steatite QMS reports and brochure extracts are the source for individual antenna-module performance and mechanical data.

Engineering interpretation

HexDF layouts, masses, system diameters, switching, converter paths, RFoF and omni-assisted detection are mmt engineering concepts and estimates.

Pattern status

Azimuth envelopes and elevation cuts are representative calculations. Housing, radome, RF core, neighbouring modules, cabling and calibration affect installed performance.

Controlled release

Only values verified through simulation, prototype measurement and environmental qualification should be published as guaranteed specifications.