

Parametric Array Transducer

Parametric Array Transducer: Sediment Profiling

The underwater parametric array transducers are designed for uses in sub-bottom profiling and are optimized to explore the first layers of sediment below the sea floor. These parametric array features narrow directivity pattern at the low frequency and seafloor penetration of tens of meters. To achieve a specific deference frequency, transducers need two high-frequency signal sources as inputs: **Low primary frequency (LPF)** signal source and **high primary frequency (HPF)** signal source. When two high-frequency underwater sound/waves (primary frequencies f_{p1} and f_{p2} , and set $f_{p1} > f_{p2}$.) propagate in the same direction, they interact with each other to create sum and difference-frequency sounds and their harmonics. The difference-frequency frequency sound/wave (secondary frequency $f_{sec} = f_{p1}-f_{p2}$) is useful for practical applications in sediment profiling, depth sounding and communication because of low propagation attenuation in water/liquids and solids. The directivity of the secondary frequency sound is close to the ones of primary frequencies. Parametric array gain or efficiency is better as primary sound powers are higher, secondary frequency f_{sec} is higher, down shift ratio ($f_{p1}+f_{p2}$)/(2 f_{sec}) is lower, and (α_p*R_r) is lower (α_p : mean primary sound attenuation coefficient; Rr: rayleigh distance). **Attenuation/absorption coefficient of sediments is frequency dependent around 0.06f to 0.6f (dB/(m*kHz)).**

Typical Applications

Sub-Bottom Investigation/Assessment/Profiler	Sediment Profiling/Sediment Penetrating	Detection of Buried Objects, Search Pipeline/Cable Survey
Synthetic Aperture Imaging & Sequential Imaging	R & D on Nonlinear Underwater Acoustics	Construction of Harbor, Coast, Estuary

SYSTEM CONFIGURATION

Transmitting Sounds.



RELATED PRODUCTS

Power Amplifier for SONAR, NDT, and HIFU	Impedance Matching between Transducers and Amplifiers

Specifications

Parametric Transdu	cer	BII7546-60	BII7546-110	BII7544-160	BII7544-195	BII7543-295	
		55 to 75 kHz	100 to 120 kHz	150 to 170 kHz	185 to 205 kHz	285 to 305 kHz	
Primary Sources f _p :		When two primary f _p = two resonance f _s of the transducer, maximum secondary source level SL _{sec} is achieved.					
		fs: Resonance Frequency of Primary Sources.					
		1. None by default.					
		2. Customization: Built-in,	mpedance matching to 50Ω	, refer to <u>Impedance Match</u>	<u>iing at fs</u> .		
Impedance Matchin	g:	TVR and FFVS variation of a	a transducer with built-in Im	pedance Matching Network	« :		
	0	1. When $R_{IM} < 1/G$, TVR inc	reases, FFVS decreases. Gen	erally, this is true for low fr	equency transducers.		
		2. When $R_{IM} > 1/G$, TVR dec	creases, FFVS increases. Gen	erally, this is true for high f	requency transducers.		
		R _{IM} : Impedance-Matched R	tesistance such as 50 Ω . G: The second se	ransducer Conductance at (Operating Frequency.		
Primary Source Sign	al:	Pulsed SINE, Chirp, PSK, FS	K, Pulsed Square Waveform,	etc.			
Radiation Face:		Circular Plane					
Directivity Pattern:		Conical Beam. Refer to Gra	ph of <u>Directivity Pattern</u> .				
Quality Factor Q _m :		4.0 to 5.5, -3dB bandwidth	$\Delta f = fs/Q_m$. Qm determines	the transient response or th	ne rise and fall rings of ste	ady-state response.	
$\eta_{ea at fs}$ at f_s :		0.5 to 0.72 0.35 to 0.6 0.3 to 0.5 0.23 to 0.3 0.3 to 0.5					
		Circular Planar Transducer: at f << fs, η_{ea} / $\eta_{ea at fs} \approx 0.1225^* (k^* \Phi D)^2$. Wave Number k = $2\pi/\lambda$; ΦD = Transducer Diameter.					
		1. Driving Transducer with Continuous Signals:					
		(1). Electroacoustic Efficiency η_{ea} is quite low at f << fs and drops gradually at f > fs, so it is NOT recommended for transducers to emit					
		high power sounds at frequencies far from fs. Otherwise, transducer may be damaged by overheating.					
n _{ea} at f << f _s :		(2). Transducer can emit lo	ow power sounds at frequen	cies far from fs. For examp	le, input power Pi ≤ ηea*Ν	IIPP at $f \le 0.8 \text{ *} f_s$ and $P_i \le$	
•		$0.2*MIPP$ at $f \ge 1.3*f_s$.					
		2. Driving Transducer with Puising Signals such as SINE Puises:					
		Electroacoustic Efficiency η_{ea} is quite low at $t << t_s$ and drops gradually at $t > t_s$, so it is recommended for transducers to emit high					
		power sounds at frequencies far from t _s with Puising Signals with Duty Cycle ≤ 10%, Puise Length ≤ 100mS. Otherwise, transducer					
may be damaged by overheating.							
Power Factor at fs:		1. No impedance matching: 0.7 ~ 0.9.					
		2. Bespoke, Impedance ma	tching to be 50Ω : ≥ 0.92		1	1	
Primary TVR at f.	HPF	170.5	172.0	169.0	176.5	173.0	
+ 2dB	LPF	160.0	168.0	165.0	172.5	168.0	
- 200.	Primar	ry TVR : Transmitting Voltage Response of two primary sound sources, dB μPa/V@1m.					



Benthowave Instrument Inc. benthowave.com

Acoustical Solutions: SONAR, NDT/AE, HIFU.

Revised on 2024/12/6

Page 2 of 5

			-	-			
Radiation Sound Lev	el SL _p :	Primary Source Level at f_p : SL _p = 20*logV _i + TVR, dB μ Pa@1m. Driving Voltage V _i is in unit of V _{rms} .					
		Refer to <u>G-B Graph</u> .					
Admittance or Impe	dance:	Customization with Built-in Impedance Matching to 50Ω : refer to Impedance Matching at f_s . Refer to Z - θ Graph.					
Tananakanan lahara	$_{\rm r}$ without Impedance Matching Unit						
Transducer without	Impeda	Pulsed Driving Signal and Duty Cycle D < 100%: Maximum V: Vince = V/MIPD/Great) or 600, whichever is less in Vince					
Driving Voltage V. at	f.	Continuous Operation at 1	Duty Cycle D < 100%: Maximum	$V_{i} V_{i} = v(V_{i} = v(V_{i} = v))$	or 600, whichever is less,	III Vrms.	
Driving voltage vi at	Ts:	Continuous Operation at 1	uol huilt in impedance met	Vi, Vimax = V(IVICIP/Gmax), IN	Vrms.	la tha transducar	
To achieve higher sound level, built-in impedance matching is recommended to step up driving voltage inside the transducer.						le the transducer.	
Transducer with him	Jeuance	Ruleod Driving Signal and I		$\sqrt{MIDD * 7 }$ in $\sqrt{7}$ is	modance with Impedance	o Matching Unit at fc	
Driving Voltage Vi at	fs:	Continuous Operation at 1	100% Duty Cycle: Maximum	$V_1 V_1 = 1/(MCIP * [7])$ in		e Matching Onit at 15.	
		No Impedance Matching:	$P_{i} = V_{i}^{2} * G$ Refer to G-B	Granh: G is conductance	Grav is maximum G at f		
Input Power P _i :		Built-in Impedance Matchi	ng: $P_i = V_i^2 / 7$ at f_c 7 is imper	dance at fo			
	HPF:	2400 Watts	3000 Watts	1500 Watts	1150 Watts	1000 Watts	
MIPP at fs:	LPF:	2400 Watts	1700 Watts	850 Watts	770 Watts	800 Watts	
	Maxim	um Input Pulse Power at f.: F	$P_i = V_i^2 * G_{max}$ or MIPP Watts.	whichever is less.			
		26 Seconds	17 Seconds	13 Seconds	10 Seconds	10 Seconds	
MPW at MIPP and fs	:	Maximum Pulse Width at N	VIPP and at fs. MPW of HPF	= MPW of LPF.			
	HPF:	76 Watts	80 Watts	56 Watts	35 Watts	30 Watts	
MCIP at f _s :	LPF:	30 Watts	40 Watts	25 Watts	25 Watts	30 Watts	
-	Maxim	um Continuous Input Power	at f _s .				
MIPP: Maximum Inp	ut Pulse	Power. MPW: Maximum Pu	lse Width. MCIP: Maximum	Continuous Input Power. f s	: Resonance Frequency.		
How to determine p	ulse wid	th, duty cycle and off-time	with input pulse power (pea	ak power) at fs:			
1. Determine the inp	ut pulse	power (IPP, peak power) wit	th sound intensity required l	by the project. IPP MUST be	e less than MIPP.		
2. Pulse Width ≤ (MI	PP * MP	W*(120°c-T)/103°c)/IPP. T: V	Vater Temperature in °c.				
3. Duty Cycle D ≤ MC	CIP*(120	°c-T)/103°c)/IPP.					
4. Off-time ≥ PW*(1-	·D)/D.	Canical Decay					
Directivity Pattern a	Isec:	f < 15 kHz f · Socondar	Fraguency f - If f l				
Maximum SL at f	Isec:	$I_{sec} \leq 15$ KHZ. I_{sec} : Secondary	y Frequency, $I_{sec} = I_{p1} - I_{p2} $.	10001			
2dP Poomwidth at f		2 200 ub μPa, 3L sec. 3001Ce			۶.0°	E E º	
-Sub Deaniwiutinati	sec.	10.0	0.0	1.5	0.0	5.5	
Side Lobe Level: \leq -17.7 dB							
Side Lobe Level:	i+	≤ -17.7 dB	ionov f	l			
Penetration Capabil	ity:	≤ -17.7 dB ≥ 40 m at Secondary frequ	iency f _{sec} .	N/A	N/A	N/A	
Penetration Capabil	ity: HPF	≤ -17.7 dB ≥ 40 m at Secondary frequ N/A -172 5	ency fsec. N/A -180 5	N/A	N/A -184.0	N/A -189.0	
FFVS at fs:	ity: HPF LPF	≤ -17.7 dB ≥ 40 m at Secondary frequ N/A -172.5	nency f _{sec} . N/A -180.5	N/A -190.6 $(2\pi f_s C_c)$, c	N/A -184.0	N/A -189.0	
FFVS at fs: ± 2 dB	ity: HPF LPF <i>FFVS</i> S	≤ -17.7 dB ≥ 40 m at Secondary frequ N/A -172.5 Sensitivity Loss over extended	Hency f _{sec} . N/A -180.5 nsion cable at $f_s(dB) = 2$	N/A -190.6 $20 * \log \left\{ \left(1 + \frac{2\pi f_s C_c}{B}\right) / \sqrt{1} \right\}$	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2$	N/A -189.0 + B ²)}	
FFVS at fs: ± 2 dB	ity: HPF LPF <i>FFVS</i> S G: Cont	≤ -17.7 dB ≥ 40 m at Secondary frequ N/A -172.5 Sensitivity Loss over extend ductance at fs; B: Susceptance	Tency f _{sec} . N/A -180.5 <i>nsion cable at f_s</i> (dB) = 2 <i>ce</i> at f _s ; C _c : Capacitance of Ex	N/A -190.6 $20 * \log \left\{ \left(1 + \frac{2\pi f_s C_c}{B}\right) / \sqrt{1} \right\}$ tension Cable. Cable is of 10	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2$ 00 pF/meter roughly.	N/A -189.0 + B ²)}	
FFVS at fs: ± 2 dB	ity: HPF LPF <i>FFVS</i> S G: Cont FFVS : F	≤ -17.7 dB ≥ 40 m at Secondary frequent N/A -172.5 Sensitivity Loss over extended ductance at fs; B: Susceptance iree-field Voltage Sensitivity,	N/A -180.5 <i>nsion cable at</i> $f_s(dB) = 2$ <i>ie at</i> f_s ; C_c : Capacitance of Ex <i>in dB</i> V/µPa.	N/A -190.6 $20 * \log \left\{ \left(1 + \frac{2\pi f_s C_c}{B}\right) / \sqrt{1} \right\}$ tension Cable. Cable is of 10	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2)$ 00 pF/meter roughly.	N/A -189.0 + B ²)}	
FFVS at fs: ± 2 dB	ity: HPF LPF <i>FFVS S</i> G: Conv FFVS : F HPF	≤ -17.7 dB ≥ 40 m at Secondary frequent N/A -172.5 Sensitivity Loss over extended ductance at fs; B: Susceptance ree-field Voltage Sensitivity, N/A	rency f _{sec} . N/A -180.5 <i>nsion cable at f_s</i> (dB) = 2 re at f _s ; C _c : Capacitance of Ex in dB V/µPa. N/A	N/A -190.6 $20 * \log \left\{ \left(1 + \frac{2\pi f_s C_c}{B}\right) / \sqrt{1} \right\}$ tension Cable. Cable is of 10 N/A	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2)$ 00 pF/meter roughly. N/A	N/A -189.0 + B ²)}	
FFVS at fs: ± 2 dB FFVS at f<: ts: + 2 dB	ity: HPF LPF <i>FFVS</i> S G: Cond FFVS : F HPF LPF Someitin	≤ -17.7 dB ≥ 40 m at Secondary freque N/A -172.5 Sensitivity Loss over extended ductance at fs; B: Susceptance ree-field Voltage Sensitivity, N/A -190.0	tency $f_{sec.}$ N/A -180.5 <i>nsion cable at</i> $f_s(dB) = 2$ te at f_s ; C_c : Capacitance of Ex in dB V/µPa. N/A -182.0 $c_s(dB) = 20$	N/A -190.6 $20 * \log \left\{ \left(1 + \frac{2\pi f_s C_c}{B}\right) / \sqrt{1} \right\}$ tension Cable. Cable is of 1 N/A -193.0	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2$ 00 pF/meter roughly. N/A -195.0 wt excemplifier	N/A -189.0 + B ²)}	
FFVS at fs: ± 2 dB FFVS at f <fs: ± 2 dB</fs: 	ity: HPF LPF G: Con FFVS: F HPF LPF Sensitiv	≤ -17.7 dB ≥ 40 m at Secondary frequ N/A -172.5 Sensitivity Loss over extenductance at fs; B: Susceptance ree-field Voltage Sensitivity, N/A -190.0 vity Loss over Extension Cabl rophone Canacitance: C: Ca	ency $f_{sec.}$ N/A -180.5 nsion cable at $f_s(dB) = 2$ the at f_s ; C_c : Capacitance of Ex- in dB V/µPa. N/A -182.0 e (dB) = 20*log[Ch/(Ch+C_c)]. \ partition cable Strension Cable	N/A -190.6 $20 * \log \left\{ \left(1 + \frac{2\pi f_s C_c}{B} \right) / \sqrt{1} \right\}$ tension Cable. Cable is of 1 N/A -193.0 Valid for hydrophone withous Cable is of 100 pE/meter	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2)$ 00 pF/meter roughly. N/A -195.0 ut preamplifier. roughly.	N/A -189.0 + B ²)} N/A -192.0	
FFVS at fs: ± 2 dB FFVS at f << fs: ± 2 dB	ity: HPF LPF G: Con- FFVS : F HPF LPF Sensitiv C _h : Hycc el SI	≤ -17.7 dB ≥ 40 m at Secondary frequ N/A -172.5 Sensitivity Loss over extend ductance at fs; B: Susceptance ree-field Voltage Sensitivity, N/A -190.0 vity Loss over Extension Cabl Irophone Capacitance; Cc: Ca SI = 20*logVo.= FEVS dB uE	ency $f_{sec.}$ N/A -180.5 nsion cable at $f_s(dB) = 2$ the at $f_s; C_c$: Capacitance of Ex- in dB V/µPa. N/A -182.0 e (dB) = 20*log[Ch/(Ch+C_c)]. pacitance of Extension Cable 2. Receiving Voltage V_s is in	N/A -190.6 $20 * \log \left\{ \left(1 + \frac{2\pi f_s C_c}{B} \right) / \sqrt{1} \right\}$ tension Cable. Cable is of 1 N/A -193.0 Valid for hydrophone without e. Cable is of 100 pF/meter unit of Varc	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2$ 00 pF/meter roughly. N/A -195.0 ut preamplifier. roughly.	N/A -189.0 + B ²)} N/A -192.0	
FFVS at fs: ± 2 dB FFVS at f << fs: ± 2 dB Receiving Sound Lev Operating Depth:	ity: HPF LPF G: Conv FFVS: F HPF LPF Sensitiv C _h : Hyc el SL:	≤ -17.7 dB ≥ 40 m at Secondary frequ N/A -172.5 Sensitivity Loss over extended ductance at fs; B: Susceptance iree-field Voltage Sensitivity, N/A -190.0 vity Loss over Extension Cable Irophone Capacitance; Cc: Ca SL = 20*logV₀ - FFVS, dB µF Maximum 300 m or 3 MP2	ency $f_{sec.}$ N/A -180.5 nsion cable at $f_s(dB) = 2$ the at f_s ; Cc: Capacitance of Ex- in dB V/μPa. N/A -182.0 e (dB) = 20*log[Ch/(Ch+Cc)]. pacitance of Extension Cable Pa. Receiving Voltage V ₀ is in a Pressure. Limited by the ca	N/A -190.6 $20 * \log \left\{ \left(1 + \frac{2\pi f_s C_c}{B} \right) / \sqrt{1} \right\}$ tension Cable. Cable is of 1 N/A -193.0 Valid for hydrophone without e. Cable is of 100 pF/meter unit of V _{rms} . ble length if the cable has y	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2$ 00 pF/meter roughly. N/A -195.0 ut preamplifier. roughly. wire leads or a non-waterr	N/A -189.0 + B ²)} N/A -192.0	
FFVS at fs: ± 2 dB FFVS at f << fs: ± 2 dB Receiving Sound Lev Operating Depth:	ity: HPF LPF G: Coni FFVS : F HPF LPF Sensitiv C _h : Hyc el SL:	≤ -17.7 dB ≥ 40 m at Secondary frequ N/A -172.5 Sensitivity Loss over extended ductance at fs; B: Susceptance ree-field Voltage Sensitivity, N/A -190.0 vity Loss over Extension Cable lrophone Capacitance; Cc: Ca SL = 20*logV₀ - FFVS, dB µF Maximum, 300 m or 3 MPa 1. Default: Free Hanging (F	ency f _{sec} . N/A -180.5 nsion cable at $f_s(dB) = 2$ is at f _s ; C _c : Capacitance of Ex- in dB V/μPa. N/A -182.0 e (dB) = 20*log[C _h /(C _h +C _c)]. pacitance of Extension Cable Da. Receiving Voltage V ₀ is in a Pressure, Limited by the ca H)	N/A -190.6 $20 * \log \left\{ \left(1 + \frac{2\pi f_s C_c}{B}\right) / \sqrt{1} \right\}$ tension Cable. Cable is of 10 N/A -193.0 Valid for hydrophone without e. Cable is of 100 pF/meter unit of V _{rms} . ble length if the cable has y	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2$ 00 pF/meter roughly. N/A -195.0 ut preamplifier. roughly. wire leads or a non-waterp	N/A -189.0 + B ²)} N/A -192.0 proof connector.	
FFVS at fs: ± 2 dB FFVS at f << fs: ± 2 dB Receiving Sound Lev Operating Depth:	ity: HPF LPF G: Conr FFVS : FFVS: F HPF LPF Sensitiv C _h : Hyc el SL:	≤ -17.7 dB ≥ 40 m at Secondary frequ N/A -172.5 Sensitivity Loss over extended ductance at fs; B: Susceptance ree-field Voltage Sensitivity, N/A -190.0 vity Loss over Extension Cable trophone Capacitance; C _c : Ca SL = 20*logV₀ - FFVS, dB µF Maximum, 300 m or 3 MPa 1. Default: Free Hanging (F 2. Bolt-Fastening Mounting	The the two processes of the two processes of the two processes of the two processes of two proceses of two processes of two processes of two processes of two	N/A -190.6 $20 * \log \left\{ \left(1 + \frac{2\pi f_s C_c}{B}\right) / \sqrt{1} \right\}$ tension Cable. Cable is of 10 N/A -193.0 Valid for hydrophone without e. Cable is of 100 pF/meter unit of V _{rms} . ble length if the cable has without 1-3/8''' : 2 x 3/8''-16 x 1.25'	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2$ 00 pF/meter roughly. N/A -195.0 ut preamplifier. roughly. wire leads or a non-waterp	N/A -189.0 + B ²)} N/A -192.0 proof connector.	
FFVS at fs: ± 2 dB FFVS at f << fs: ± 2 dB Receiving Sound Lev Operating Depth:	ity: HPF LPF G: Cond FFVS : FFVS: F HPF LPF Sensitiv C _h : Hycc el SL:	 ≤ -17.7 dB ≥ 40 m at Secondary frequency N/A -172.5 Sensitivity Loss over extended ductance at fs; B: Susceptance ree-field Voltage Sensitivity, N/A -190.0 vity Loss over Extension Cable lrophone Capacitance; C_c: Ca SL = 20*logV₀ - FFVS, dB µF Maximum, 300 m or 3 MPa Default: Free Hanging (F Bolt-Fastening Mounting Free-hanging with Male 	tency f_{sec} . N/A -180.5 <i>nsion cable at</i> $f_s(dB) = 2$ are at f_s ; C_c : Capacitance of Ex- in dB V/µPa. N/A -182.0 e (dB) = 20*log[C _h /(C _h +C _c)]. pacitance of Extension Cable Pa. Receiving Voltage V ₀ is in a Pressure, Limited by the ca H) g with Free Hanging (BFM-FH Underwater Connector (FHI	N/A -190.6 $20 * \log \left\{ \left(1 + \frac{2\pi f_s C_c}{B}\right) / \sqrt{1} \right\}$ tension Cable. Cable is of 1 N/A -193.0 Valid for hydrophone withous c. Cable is of 100 pF/meter unit of V _{rms} . ble length if the cable has withous H-3/8"): 2 x 3/8"-16 x 1.25' JWC-2P, FHUWC-3P.)	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2$ 00 pF/meter roughly. N/A -195.0 ut preamplifier. roughly. wire leads or a non-waterp 2 316 SS Screw.	N/A -189.0 + B ²)} N/A -192.0 proof connector.	
FFVS at fs: ± 2 dB FFVS at f << fs: ± 2 dB Receiving Sound Lev Operating Depth: Mounting Options:	ity: HPF LPF G: Cond FFVS: F HPF LPF Sensitiv C _h : Hyc el SL:	 ≤ -17.7 dB ≥ 40 m at Secondary frequency N/A -172.5 Sensitivity Loss over extended ductance at fs; B: Susceptance ree-field Voltage Sensitivity, N/A -190.0 vity Loss over Extension Cable rophone Capacitance; Cc: Ca SL = 20*logV₀ - FFVS, dB µF Maximum, 300 m or 3 MPa Default: Free Hanging (F Bolt-Fastening Mounting Free-hanging with Male End-face Mounting (EFM) 	tency $f_{sec.}$ N/A -180.5 <i>nsion cable at $f_s(dB) = 2$</i> the at $f_s; C_c$: Capacitance of Ex- in dB V/µPa. N/A -182.0 e (dB) = 20*log[C _h /(C _h +C _c)]. pacitance of Extension Cable Pa. Receiving Voltage V ₀ is in a Pressure, Limited by the ca H) g with Free Hanging (BFM-FH Underwater Connector (FHU IM)	N/A -190.6 $20 * \log \left\{ \left(1 + \frac{2\pi f_s C_c}{B}\right) / \sqrt{1} \right\}$ tension Cable. Cable is of 10 N/A -193.0 Valid for hydrophone withous c. Cable is of 100 pF/meter unit of V _{rms} . ble length if the cable has weighted by the	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2$ 00 pF/meter roughly. N/A -195.0 ut preamplifier. roughly. wire leads or a non-waterp ' 316 SS Screw.	N/A -189.0 + B ²)} N/A -192.0 proof connector.	
FFVS at fs: ± 2 dB FFVS at f << fs: ± 2 dB Receiving Sound Lev Operating Depth: Mounting Options:	ity: HPF LPF G: Cont FFVS: F HPF LPF Sensitiv C _h : Hyc el SL:	≤ -17.7 dB ≥ 40 m at Secondary frequence N/A -172.5 Sensitivity Loss over extended Sensitivity Loss over extended ductance at fs; B: Susceptance ree-field Voltage Sensitivity, N/A -190.0 vity Loss over Extension Cable Irophone Capacitance; Cc: Ca SL = 20*logV₀ - FFVS, dB µF Maximum, 300 m or 3 MPa 1. Default: Free Hanging (F 2. Bolt-Fastening Mounting 3. Free-hanging with Male 4. End-face Mounting (FGM-	tency f _{sec} . N/A -180.5 <i>nsion cable at f_s (dB) = 2</i> te at f _s ; C _c : Capacitance of Ex- in dB V/μPa. N/A -182.0 e (dB) = 20*log[C _h /(C _h +C _c)]. N pacitance of Extension Cable Pa. Receiving Voltage V ₀ is in a Pressure, Limited by the ca- H) g with Free Hanging (BFM-FH Underwater Connector (FHU MM) Φ220, FGM-Φ165, FGM-Φ1	N/A -190.6 20 * log { $\left(1 + \frac{2\pi f_s C_c}{B}\right)/\sqrt{[1]}$ tension Cable. Cable is of 10 N/A -193.0 Valid for hydrophone without e. Cable is of 100 pF/meter unit of Vrms. ble length if the cable has without the cable has without a set of the	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2$ 00 pF/meter roughly. N/A -195.0 ut preamplifier. roughly. wire leads or a non-waterp ' 316 SS Screw.	N/A -189.0 + B ²)} N/A -192.0 proof connector.	
Side Lobe Level: Penetration Capabil FFVS at fs: ± 2 dB FFVS at f << fs:	ity: HPF LPF G: Con FFVS: F HPF LPF Sensitiv C _h : Hyc el SL:	 ≤ -17.7 dB ≥ 40 m at Secondary frequency N/A -172.5 Sensitivity Loss over extended of the second second	ency f _{sec} . N/A -180.5 nsion cable at $f_s(dB) = 2$ the at $f_s; C_c$: Capacitance of Ex- in dB V/μPa. N/A -182.0 e (dB) = 20*log[C _h /(C _h +C _c)]. N pacitance of Extension Cable Pa. Receiving Voltage V ₀ is in a Pressure, Limited by the ca- H) g with Free Hanging (BFM-FH Underwater Connector (FH M) Φ220, FGM-Φ165, FGM-Φ1 for	N/A -190.6 $20 * \log \left\{ \left(1 + \frac{2\pi f_s C_c}{B} \right) / \sqrt{1} \right\}$ tension Cable. Cable is of 10 N/A -193.0 Valid for hydrophone without e. Cable is of 100 pF/meter unit of Vrms. ble length if the cable has without the length if the cable has without H-3/8"): 2 x 3/8"-16 x 1.25' JWC-2P, FHUWC-3P.) 40.) or a complete list of Mounting	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2$ 00 pF/meter roughly. N/A -195.0 ut preamplifier. roughly. wire leads or a non-waterp ' 316 SS Screw. ng Options and more deta	N/A -189.0 + B ²)} N/A -192.0 proof connector.	
Side Lobe Level: Penetration Capabil FFVS at fs: ± 2 dB FFVS at f << fs:	ity: HPF LPF G: Con FFVS: F HPF LPF Sensitiv C _h : Hyc el SL:	 ≤ -17.7 dB ≥ 40 m at Secondary frequing N/A -172.5 Sensitivity Loss over extended to the second s	ency $f_{sec.}$ N/A -180.5 nsion cable at $f_s(dB) = 2$ the at $f_s; C_c$: Capacitance of Ex- in dB V/µPa. N/A -182.0 e (dB) = 20*log[Ch/(Ch+C_c)]. upacitance of Extension Cable Pa. Receiving Voltage V ₀ is in a Pressure, Limited by the ca H) g with Free Hanging (BFM-FH Underwater Connector (FHU MM) Φ220, FGM-Φ165, FGM-Φ1 iment AcousticSystem.pdf for a Cable (SC), Rubber or PVC J	N/A -190.6 $20 * \log \left\{ \left(1 + \frac{2\pi f_s C_c}{B} \right) / \sqrt{1} \right\}$ tension Cable. Cable is of 1 N/A -193.0 Valid for hydrophone without e. Cable is of 100 pF/meter unit of Vrms. ble length if the cable has without the length if the cable has without H-3/8"): 2 x 3/8"-16 x 1.25' JWC-2P, FHUWC-3P.) 40.) or a complete list of Mounting acket.	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2$ 00 pF/meter roughly. N/A -195.0 ut preamplifier. roughly. wire leads or a non-waterp ' 316 SS Screw. ng Options and more deta	N/A -189.0 + B ²)} N/A -192.0 proof connector.	
Side Lobe Level: Penetration Capabil FFVS at fs: ± 2 dB FFVS at f << fs:	ity: HPF LPF G: Con FFVS : F HPF LPF Sensitir C _h : Hyc el SL:	≤ -17.7 dB ≥ 40 m at Secondary frequ N/A -172.5 Sensitivity Loss over extended ductance at f _s ; B: Susceptance ree-field Voltage Sensitivity, N/A -190.0 vity Loss over Extension Cabl rophone Capacitance; C _c : Ca SL = 20*logV ₀ - FFVS, dB μF Maximum, 300 m or 3 MPa 1. Default: Free Hanging (F 2. Bolt-Fastening Mounting 3. Free-hanging with Male 4. End-face Mounting (FGM- Please refer to online docu 1. Two Conductor Shielded 2. 50 Ω RG58 Coax (RG58) Handling: Do not use theo	ency $f_{sec.}$ N/A -180.5 nsion cable at $f_s(dB) = 2$ the at $f_s; C_c$: Capacitance of Ex- in dB V/µPa. N/A -182.0 e (dB) = 20*log[Ch/(Ch+C_c)]. · pacitance of Extension Cable Pa. Receiving Voltage V ₀ is in a Pressure, Limited by the ca- H) g with Free Hanging (BFM-FH Underwater Connector (FHU IM) Φ220, FGM-Φ165, FGM-Φ1 iment <u>AcousticSystem.pdf</u> for d Cable (SC), Rubber or PVC J	N/A -190.6 $20 * \log \left\{ \left(1 + \frac{2\pi f_s C_c}{B} \right) / \sqrt{1} \right\}$ tension Cable. Cable is of 1 N/A -193.0 Valid for hydrophone without e. Cable is of 100 pF/meter unit of Vrms. ble length if the cable has without the length if the cable has without H-3/8"): 2 x 3/8"-16 x 1.25' JWC-2P, FHUWC-3P.) 40.) or a complete list of Mounti acket.	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2$ 00 pF/meter roughly. N/A -195.0 ut preamplifier. roughly. wire leads or a non-waterp ' 316 SS Screw. ng Options and more deta	N/A -189.0 + B ²)} N/A -192.0 proof connector.	
Side Lobe Level: Penetration Capabil FFVS at fs: ± 2 dB FFVS at f << fs:	ity: HPF LPF G: Con FFVS : F HPF LPF Sensitiv C _h : Hyc el SL:	≤ -17.7 dB ≥ 40 m at Secondary frequ N/A -172.5 Sensitivity Loss over extended ductance at fs; B: Susceptance iree-field Voltage Sensitivity, N/A -190.0 vity Loss over Extension Cable Irophone Capacitance; Cc: Ca SL = 20*logV₀ - FFVS, dB µF Maximum, 300 m or 3 MPa 1. Default: Free Hanging (F 2. Bolt-Fastening Mounting 3. Free-hanging with Male 4. End-face Mounting (FGM-1) Please refer to online docu 1. Two Conductor Shielded 2. 50 Ω RG58 Coax (RG58) Handling: Do not use the of the cable.	ency f _{sec} . N/A -180.5 nsion cable at $f_s(dB) = 2$ the at f _s ; Cc: Capacitance of Ex- in dB V/μPa. N/A -182.0 e (dB) = 20*log[Ch/(Ch+Cc)]. · pacitance of Extension Cable Pa. Receiving Voltage V _o is in a Pressure, Limited by the ca- H) g with Free Hanging (BFM-FH Underwater Connector (FHU MM) Φ220, FGM-Φ165, FGM-Φ1 Imment AcousticSystem.pdf for d Cable (SC), Rubber or PVC J cable to support transducer	N/A -190.6 $20 * \log \left\{ \left(1 + \frac{2\pi f_s C_c}{B} \right) / \sqrt{1} \right\}$ tension Cable. Cable is of 1 N/A -193.0 Valid for hydrophone withous e. Cable is of 100 pF/meter unit of Vrms. ble length if the cable has without the	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2$ 00 pF/meter roughly. N/A -195.0 ut preamplifier. roughly. wire leads or a non-waterp 7 316 SS Screw. ng Options and more deta the transducer has a mou	N/A -189.0 + B ²)} N/A -192.0 proof connector. ills. inting part. Do not bend	
Side Lobe Level: Penetration Capabil FFVS at fs: ± 2 dB FFVS at f << fs:	ity: HPF LPF G: Con FFVS : F HPF LPF Sensitiv C _h : Hyc el SL:	 ≤ -17.7 dB ≥ 40 m at Secondary frequing N/A -172.5 Sensitivity Loss over extended to the second second	ency f _{sec} . N/A -180.5 nsion cable at $f_s(dB) = 2$ the at f _s ; Cc: Capacitance of Ex- in dB V/μPa. N/A -182.0 e (dB) = 20*log[Ch/(Cn+Cc)]. 1 pacitance of Extension Cable Pa. Receiving Voltage V ₀ is in a Pressure, Limited by the ca- H) g with Free Hanging (BFM-FH Underwater Connector (FHU IM) Φ220, FGM-Φ165, FGM-Φ1 Iment AcousticSystem.pdf fc d Cable (SC), Rubber or PVC J cable to support transducer underwater connector. 0.6m	N/A -190.6 20 * log { $\left(1 + \frac{2\pi f_s C_c}{B}\right)/\sqrt{1}$ tension Cable. Cable is of 1 N/A -193.0 Valid for hydrophone withous e. Cable is of 100 pF/meter unit of Vrms. ble length if the cable has of H-3/8"): 2 x 3/8"-16 x 1.25' JWC-2P, FHUWC-3P.) 40.) or a complete list of Mounti acket. weight in air and water if m with Underwater Mateabl	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2$ 00 pF/meter roughly. N/A -195.0 ut preamplifier. roughly. wire leads or a non-waterp ' 316 SS Screw. ng Options and more deta the transducer has a mou e Connector (2 pins) (UM	N/A -189.0 + B ²)} N/A -192.0 proof connector. proof connector.	
Side Lobe Level: Penetration Capabil FFVS at fs: ± 2 dB FFVS at f << fs:	ity: HPF LPF G: Cond FFVS : HPF LPF Sensitiv C _h : Hyc el SL:	≤ -17.7 dB ≥ 40 m at Secondary frequ N/A -172.5 Sensitivity Loss over extended ductance at fs; B: Susceptance ree-field Voltage Sensitivity, N/A -190.0 vity Loss over Extension Cable trophone Capacitance; Cc: Ca SL = 20*logV₀ - FFVS, dB µF Maximum, 300 m or 3 MPa 1. Default: Free Hanging (F 2. Bolt-Fastening Mounting 3. Free-hanging with Male 4. End-face Mounting (FGM- Please refer to online docu 1. Two Conductor Shielded 2. 50 Ω RG58 Coax (RG58) Handling: Do not use the of the cable. 1. Default: 15 m with non-to 2. Custom-fit.	ency f _{sec} . N/A -180.5 nsion cable at $f_s(dB) = 2$ the at f _s ; Cc: Capacitance of Ex- in dB V/μPa. N/A -182.0 e (dB) = 20*log[Ch/(Ch+Cc]]. pacitance of Extension Cable Pa. Receiving Voltage Vo is in a Pressure, Limited by the ca- in a Pressure, Limited by the ca- cable (SC), Rubber or PVC J cable to support transducer underwater connector. 0.6m	N/A -190.6 $20 * \log \left\{ \left(1 + \frac{2\pi f_s C_c}{B} \right) / \sqrt{1} \right\}$ tension Cable. Cable is of 10 N/A -193.0 Valid for hydrophone without c. Cable is of 100 pF/meter unit of Vrms. ble length if the cable has of H-3/8"): 2 x 3/8"-16 x 1.25' JWC-2P, FHUWC-3P.) 40.) or a complete list of Mountiacket. weight in air and water if in with Underwater Mateable	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2$ 00 pF/meter roughly. N/A -195.0 ut preamplifier. roughly. wire leads or a non-waterp ' 316 SS Screw. ng Options and more deta the transducer has a mou e Connector (2 pins) (UM	N/A -189.0 + B ²)} N/A -192.0 proof connector. wills. anting part. Do not bend C2P).	
Side Lobe Level: Penetration Capabil FFVS at fs: ± 2 dB FFVS at f << fs:	ity: HPF LPF G: Cont FFVS : HPF LPF Sensitiv C _h : Hyc el SL:	 ≤ -17.7 dB ≥ 40 m at Secondary frequency N/A -172.5 Sensitivity Loss over extended of the second secon	ency f _{sec} . N/A -180.5 nsion cable at $f_s(dB) = 2$ is at f _s ; C _c : Capacitance of Ex- in dB V/μPa. N/A -182.0 e (dB) = 20*log[C _h /(C _h +C _c)]. pacitance of Extension Cable Pa. Receiving Voltage V ₀ is in a Pressure, Limited by the ca- H) g with Free Hanging (BFM-FH Underwater Connector (FHU MM) Φ220, FGM-Φ165, FGM-Φ1 iment AcousticSystem.pdf for a Cable (SC), Rubber or PVC J cable to support transducer underwater connector. 0.6m), for Transmit, Receive Sign	N/A -190.6 20 * log { $\left(1 + \frac{2\pi f_s C_c}{B}\right)/\sqrt{1}$ tension Cable. Cable is of 10 N/A -193.0 Valid for hydrophone without c. Cable is of 100 pF/meter unit of Vrms. ble length if the cable has without the cable has with 2 x 3/8"-16 x 1.25' JWC-2P, FHUWC-3P.) 40.) or a complete list of Mountiacket. weight in air and water if in with Underwater Mateable al, and DC Power Supply.	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2)$ 00 pF/meter roughly. N/A -195.0 ut preamplifier. roughly. wire leads or a non-waterp ' 316 SS Screw. ng Options and more deta the transducer has a mou e Connector (2 pins) (UMG)	N/A -189.0 + B ²)} N/A -192.0 proof connector. proof connector. iils. iils. c2P).	
Side Lobe Level: Penetration Capabil FFVS at fs: ± 2 dB FFVS at f << fs:	ity: HPF LPF G: Cond FFVS: F HPF LPF Sensitiv C _h : Hyc el SL:	 ≤ -17.7 dB ≥ 40 m at Secondary frequing N/A -172.5 Sensitivity Loss over extended to the second second	ency f _{sec} . N/A -180.5 nsion cable at $f_s(dB) = 2$ the at $f_s; C_c$: Capacitance of Ex- in dB V/μPa. N/A -182.0 e (dB) = 20*log[C _h /(C _h +C _c)]. N pacitance of Extension Cable Pa. Receiving Voltage V ₀ is in a Pressure, Limited by the ca- H) g with Free Hanging (BFM-FH Underwater Connector (FHU MM) Φ220, FGM-Φ165, FGM-Φ1 Imment AcousticSystem.pdf for i Cable (SC), Rubber or PVC J cable to support transducer underwater connector. 0.6m), for Transmit, Receive Sign onnector (2 pins) (UMC2P) (or anote (2 pins) (UMC2P) (N/A -190.6 20 * log { $\left(1 + \frac{2\pi f_s C_c}{B}\right)/\sqrt{1}$ tension Cable. Cable is of 10 N/A -193.0 Valid for hydrophone without e. Cable is of 100 pF/meter unit of Vrms. ble length if the cable has without the cable has without a start of the cable has with H-3/8"): 2 x 3/8"-16 x 1.25' JWC-2P, FHUWC-3P.) 40.) or a complete list of Mountiacket. weight in air and water iff in with Underwater Mateable al, and DC Power Supply. Max. Diameter Φ 21.5 to Φ	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2)$ 00 pF/meter roughly. N/A -195.0 ut preamplifier. roughly. wire leads or a non-waterp ' 316 SS Screw. ng Options and more deta the transducer has a mou e Connector (2 pins) (UMG 35 mm). Locking Sleeve: D	N/A -189.0 + B ²)} N/A -192.0 proof connector. proof connector. iils. construction iils. iils. LSA-M.	
Side Lobe Level: Penetration Capabil FFVS at fs: ± 2 dB FFVS at f << fs:	ity: HPF LPF G: Cond FFVS: F HPF LPF Sensitiv C _h : Hyc el SL:	 ≤ -17.7 dB ≥ 40 m at Secondary frequing N/A -172.5 Sensitivity Loss over extended to the second second	ency f _{sec} . N/A -180.5 nsion cable at $f_s(dB) = 2$ the at $f_s; C_c$: Capacitance of Ex- in dB V/μPa. N/A -182.0 e (dB) = 20*log[C _h /(C _h +C _c)]. · upacitance of Extension Cable Pa. Receiving Voltage V ₀ is in a Pressure, Limited by the ca H) g with Free Hanging (BFM-FH Underwater Connector (FH M) Φ220, FGM-Φ165, FGM-Φ1 imment AcousticSystem.pdf for a Cable (SC), Rubber or PVC J cable to support transducer underwater connector. 0.6m), for Transmit, Receive Sign onnector (2 pins) (UMC2P) (onnector (3 pins) (UMC3P) (onnector (3 pins) (UMC3P) (N/A -190.6 $20 * \log \left\{ \left(1 + \frac{2\pi f_s C_c}{B}\right) / \sqrt{1} \right\}$ tension Cable. Cable is of 10 N/A -193.0 Valid for hydrophone without e. Cable is of 100 pF/meter unit of Vrms. ble length if the cable has without the cable has without the cable has with th	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2)$ 00 pF/meter roughly. N/A -195.0 ut preamplifier. roughly. wire leads or a non-waterp '316 SS Screw. ng Options and more deta the transducer has a mou e Connector (2 pins) (UMi 35 mm). Locking Sleeve: D 35 mm). Locking Sleeve: D	N/A -189.0 + B ²)} N/A -192.0 proof connector. ills. inting part. Do not bend C2P). LSA-M. LSA-M. LSA-M.	
Side Lobe Level: Penetration Capabil FFVS at fs: ± 2 dB FFVS at f << fs:	ity: HPF LPF G: Con FFVS: F HPF LPF Sensitiv C _h : Hyc el SL:	 ≤ -17.7 dB ≥ 40 m at Secondary frequing N/A -172.5 Sensitivity Loss over extended to the second second	Pency $f_{sec.}$ N/A -180.5 Insion cable at $f_s(dB) = 2$ the at $f_s; C_c$: Capacitance of Ex- in dB V/µPa. N/A -182.0 e (dB) = 20*log[Ch/(Ch+C_c)]. 1 upacitance of Extension Cable Pa. Receiving Voltage V ₀ is in a Pressure, Limited by the ca H) g with Free Hanging (BFM-FH Underwater Connector (FHU MM) Φ220, FGM-Φ165, FGM-Φ1 iment AcousticSystem.pdf for a Cable (SC), Rubber or PVC J cable to support transducer underwater connector. 0.6m c), for Transmit, Receive Sign onnector (2 pins) (UMC2P) (onnectors are fixed with C er is listed in quote in detail	N/A -190.6 $20 * \log \left\{ \left(1 + \frac{2\pi f_s C_c}{B}\right) / \sqrt{1} \right\}$ tension Cable. Cable is of 10 N/A -193.0 Valid for hydrophone without e. Cable is of 100 pF/meter unit of Vrms. ble length if the cable has without the cable has without a state of the cable has with H-3/8"): 2 x 3/8"-16 x 1.25' JWC-2P, FHUWC-3P.) 40.) or a complete list of Mountian acket. weight in air and water if in with Underwater Mateable al, and DC Power Supply. Max. Diameter Φ 21.5 to Φ Max. Diameter Φ 21.5 to Φ 0.6m unshielded cable. Un	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2)$ 00 pF/meter roughly. N/A -195.0 ut preamplifier. roughly. wire leads or a non-waterp '316 SS Screw. ng Options and more deta the transducer has a mouter of the transduce	N/A -189.0 + B ²)} N/A -192.0 proof connector. proof connector. proof connector. creating part. Do not bend C2P). LSA-M. LSA-M. LSA-M. iacturers of underwater	
Side Lobe Level: Penetration Capabil FFVS at fs: ± 2 dB FFVS at f << fs:	ity: HPF LPF G: Con. FFVS: F HPF LPF Sensitiv C _h : Hyc el SL:	≤ -17.7 dB ≥ 40 m at Secondary frequ N/A -172.5 Sensitivity Loss over extended ductance at f _s ; B: Susceptance ree-field Voltage Sensitivity, N/A -190.0 vity Loss over Extension Cabl rophone Capacitance; C _c : Ca SL = 20*logV ₀ - FFVS, dB μF Maximum, 300 m or 3 MPa 1. Default: Free Hanging (F 2. Bolt-Fastening Mounting 3. Free-hanging with Male 4. End-face Mounting (FGM- Please refer to online docu 1. Two Conductor Shielded 2. 50 Ω RG58 Coax (RG58) Handling: Do not use the of the cable. 1. Default: 15 m with non-to 2. Custom-fit. 1. Default: Wire Leads (WL 2. Underwater Mateable C Underwater Mateable C Un	ency $f_{sec.}$ N/A -180.5 nsion cable at $f_s(dB) = 2$ the at $f_s; C_c$: Capacitance of Ex- in dB V/µPa. N/A -182.0 e (dB) = 20*log[Ch/(Ch+C_c)]. 1 upacitance of Extension Cable Pa. Receiving Voltage V ₀ is in a Pressure, Limited by the ca H) g with Free Hanging (BFM-FH Underwater Connector (FHU MM) Φ220, FGM-Φ165, FGM-Φ1 iment <u>AcousticSystem.pdf</u> for a Cable (SC), Rubber or PVC J cable to support transducer underwater connector. 0.6m onnector (2 pins) (UMC2P) (onnector (3 pins) (UMC3P) (connectors are fixed with C er is listed in quote in detail. WIL3P) (Max. Diameter Φ19	N/A -190.6 $20 * \log \left\{ \left(1 + \frac{2\pi f_s C_c}{B} \right) / \sqrt{1} \right\}$ tension Cable. Cable is of 11 N/A -193.0 Valid for hydrophone without e. Cable is of 100 pF/meter unit of Vrms. ble length if the cable has without to V-3/8"): 2 x 3/8"-16 x 1.25' JWC-2P, FHUWC-3P.) 40.) or a complete list of Mounti acket. weight in air and water if n with Underwater Mateable al, and DC Power Supply. Max. Diameter Φ 21.5 to Φ Max. Diameter Φ 21.5 to Φ 0.6m unshielded cable. Uf to Φ 30 mm).	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2)$ 00 pF/meter roughly. N/A -195.0 ut preamplifier. roughly. wire leads or a non-waterp '316 SS Screw. ng Options and more deta the transducer has a mouter of the transduce	N/A -189.0 + B ²)} N/A -192.0 proof connector. proof connector. iils. iils. LSA-M. LSA-M.	
Side Lobe Level: Penetration Capabil FFVS at fs: ± 2 dB FFVS at f << fs:	ity: HPF LPF G: Con. FFVS: F HPF LPF Sensitiv C _h : Hyc el SL:	 ≤ -17.7 dB ≥ 40 m at Secondary frequency N/A -172.5 Sensitivity Loss over extended of the second secon	ency $f_{sec.}$ N/A -180.5 nsion cable at $f_s(dB) = 2$ the at $f_s; C_c$: Capacitance of Ex- in dB V/µPa. N/A -182.0 e (dB) = 20*log[Ch/(Ch+C_c)]. · pacitance of Extension Cable Pa. Receiving Voltage V ₀ is in a Pressure, Limited by the ca- H) g with Free Hanging (BFM-FH Underwater Connector (FHU IM) D220, FGM-D165, FGM-D1 iment <u>AcousticSystem.pdf</u> fcd d Cable (SC), Rubber or PVC J cable to support transducer underwater connector. 0.6m), for Transmit, Receive Sign onnector (2 pins) (UMC2P) (onnector (3 pins) (UMC3P) (connectors are fixed with C er is listed in quote in detail. VIL3P) (Max. Diameter Ф19 hale Pins (XLR3P), (Max. Diar	N/A -190.6 $20 * \log \left\{ \left(1 + \frac{2\pi f_s C_c}{B} \right) / \sqrt{1} \right\}$ tension Cable. Cable is of 1 N/A -193.0 Valid for hydrophone without e. Cable is of 100 pF/meter unit of Vrms. ble length if the cable has without to Vrms. 1-3/8" : 2 x 3/8"-16 x 1.25' JWC-2P, FHUWC-3P.) 40.) or a complete list of Mountian acket. weight in air and water if n with Underwater Mateable al, and DC Power Supply. Max. Diameter $\Phi 21.5$ to Φ Max. Diameter $\Phi 21.5$ to Φ 0.6m unshielded cable. Uf to $\Phi 30$ mm). neter $\Phi 20.2$ mm).	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2)$ 00 pF/meter roughly. N/A -195.0 ut preamplifier. roughly. wire leads or a non-waterp '316 SS Screw. ng Options and more deta the transducer has a mouter e Connector (2 pins) (UMG 35 mm). Locking Sleeve: D 35 mm). Locking Sleeve: D MC is from global manuf	N/A -189.0 + B ²)} N/A -192.0 proof connector. proof connector. iils. iils. LSA-M. LSA-M. Facturers of underwater	
Side Lobe Level: Penetration Capabil FFVS at fs: ± 2 dB FFVS at f << fs:	ity: HPF LPF G: Con FFVS : F HPF LPF Sensitiv C _h : Hyc el SL:	≤ -17.7 dB ≥ 40 m at Secondary frequ N/A -172.5 Sensitivity Loss over extended ductance at f _s ; B: Susceptance iree-field Voltage Sensitivity, N/A -190.0 vity Loss over Extension Cable Irophone Capacitance; C _c : Ca SL = 20*logV ₀ - FFVS, dB µF Maximum, 300 m or 3 MPa 1. Default: Free Hanging (F 2. Bolt-Fastening Mounting 3. Free-hanging with Male 4. End-face Mounting (FGM- Please refer to online docu 1. Two Conductor Shielded 2. 50 Ω RG58 Coax (RG58) Handling: Do not use the cable. 1. Default: 15 m with non- 2. Custom-fit. 1. Default: 15 m with non- 2. Custom-fit. 1. Default: Wire Leads (WL 2. Underwater Mateable C Underwater	ency $f_{sec.}$ N/A -180.5 nsion cable at $f_s(dB) = 2$ the at $f_s; C_c:$ Capacitance of Ex- in dB V/µPa. N/A -182.0 e (dB) = 20*log[Ch/(Ch+C_c)]. · ppacitance of Extension Cable Pa. Receiving Voltage V ₀ is in a Pressure, Limited by the ca- H) g with Free Hanging (BFM-FH Underwater Connector (FHU MM) Ф220, FGM-Ф165, FGM-Ф1 iment AcousticSystem.pdf for d Cable (SC), Rubber or PVC J cable to support transducer underwater connector. 0.6m), for Transmit, Receive Sign onnector (2 pins) (UMC2P) (onnectors are fixed with C er is listed in quote in detail. MIL3P) (Max. Diameter Ф19 fale Pins (XLR3P), (Max. Diar fale Pins (DIN3P), (Max. Diar	N/A -190.6 $20 * \log \left\{ \left(1 + \frac{2\pi f_s C_c}{B}\right) / \sqrt{1} \right\}$ tension Cable. Cable is of 1 N/A -193.0 Valid for hydrophone withce e. Cable is of 100 pF/meter unit of Vrms. ble length if the cable has without the cable is of 100 pF/meter H-3/8" : 2 x 3/8"-16 x 1.25' JWC-2P, FHUWC-3P.) 40.) or a complete list of Mountiacket. weight in air and water if in with Underwater Mateable al, and DC Power Supply. Max. Diameter $\Phi 21.5$ to Φ Max. Diameter $\Phi 21.5$ to Φ 0.6m unshielded cable. UI to $\Phi 30$ mm). meter $\Phi 20.2$ mm). meter $\Phi 17$ mm).	N/A -184.0 G ² + (B + 2πf _s C _c) ²]/(G ² 00 pF/meter roughly. N/A -195.0 ut preamplifier. roughly. wire leads or a non-waterp ' 316 SS Screw . ng Options and more deta the transducer has a mou e Connector (2 pins) (UM 35 mm). Locking Sleeve: D 35 mm). Locking Sleeve: D MC is from global manuf	N/A -189.0 + B ²)} N/A -192.0 proof connector. proof connector. iils. iils. LSA-M. LSA-M. Facturers of underwater	
Side Lobe Level: Penetration Capabil FFVS at fs: ± 2 dB FFVS at f << fs:	ity: HPF LPF G: Con FFVS : HPF LPF Sensitiv C _h : Hyc el SL:	 ≤ -17.7 dB ≥ 40 m at Secondary frequency N/A -172.5 Sensitivity Loss over extended outdance at fs; B: Susceptance ree-field Voltage Sensitivity, N/A -190.0 vity Loss over Extension Cable rophone Capacitance; Cc: Ca SL = 20*logVo - FFVS, dB µF Maximum, 300 m or 3 MPa 1. Default: Free Hanging (F2. Bolt-Fastening Mounting) 3. Free-hanging with Male 4. End-face Mounting (FGM-Please refer to online docut) 1. Two Conductor Shielded 2. 50 Ω RG58 Coax (RG58) Handling: Do not use the other cable. 1. Default: 15 m with non-12. Custom-fit. 1. Default: 15 m with non-12. Custom-fit. 1. Default: 15 m the cable Cunderwater Mateable CUnderwater Mateable COUnderwater Mateable COUnderwater Mateable COUnderwater Mateable COUnderwater Mateable COUnderwater Mateable COUNDERVERS (BNC) (Max. DN) Male BNC (BNC) (Max. DN) 	ency f _{sec} . N/A -180.5 nsion cable at $f_s(dB) = 2$ the at f _s ; Cc: Capacitance of Ex- in dB V/μPa. N/A -182.0 e (dB) = 20*log[Ch/(Cn+Cc)]. 1 pacitance of Extension Cable Pa. Receiving Voltage V ₀ is in a Pressure, Limited by the ca- H) g with Free Hanging (BFM-FH Underwater Connector (FHU 1M) Φ220, FGM-Φ165, FGM-Φ1 Iment AcousticSystem.pdf fcd d Cable (SC), Rubber or PVC J cable to support transducer underwater connector. 0.6rr chable to support transducer (connector (2 pins) (UMC2P) (connector (3 pins) (UMC3P) (connector sare fixed with Ca- er is listed in quote in detail. MIL3P) (Max. Diameter Φ19 hale Pins (XLR3P), (Max. Diar Diameter Φ14.3 mm).	N/A -190.6 $20 * \log \left\{ \left(1 + \frac{2\pi f_s C_c}{B}\right) / \sqrt{1} \right\}$ tension Cable. Cable is of 1 N/A -193.0 Valid for hydrophone withous e. Cable is of 100 pF/meter unit of Vrms. ble length if the cable has without the cable is of 100 pF/meter unit of Vrms. ble length if the cable has without the cable is of 100 pF/meter unit of Vrms. ble length if the cable has without the cable is of 100 pF/meter 40.) or a complete list of Mountian the cable has without the cable is of 100 pF/meter is of 100 pF/meter 40.) or a complete list of Mountian the cable has with Underwater Mater if in with Underwater Mater if in with Underwater Mater if al, and DC Power Supply. Max. Diameter $\Phi 21.5$ to Φ 0.6m unshielded cable. Uf to $\Phi 30$ mm). meter $\Phi 20.2$ mm). meter $\Phi 17$ mm).	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2)$ 00 pF/meter roughly. N/A -195.0 ut preamplifier. roughly. wire leads or a non-waterp 316 SS Screw. ng Options and more deta the transducer has a mouter e Connector (2 pins) (UMM) 35 mm). Locking Sleeve: D 35 mm). Locking Sleeve: D MC is from global manual	N/A -189.0 + B ²)} N/A -192.0 proof connector. proof connector. iils. uting part. Do not bend C2P). LSA-M. ISA-M. iacturers of underwater	
Side Lobe Level: Penetration Capabil FFVS at fs: ± 2 dB FFVS at f << fs:	ity: HPF LPF G: Cont FFVS : HPF LPF Sensitiv C _h : Hyc el SL:	 ≤ -17.7 dB ≥ 40 m at Secondary frequency N/A -172.5 Sensitivity Loss over extended of the second secon	ency f _{sec} . N/A -180.5 nsion cable at $f_s(dB) = 2$ te at f _s ; Cc: Capacitance of Ex- in dB V/μPa. N/A -182.0 e (dB) = 20*log[Ch/(Ch+Cc]]. pacitance of Extension Cable 2a. Receiving Voltage V ₀ is in a Pressure, Limited by the ca- ih) g with Free Hanging (BFM-FH Underwater Connector (FHU MM) Φ220, FGM-Φ165, FGM-Φ1 imment AcousticSystem.pdf fcd d Cable (SC), Rubber or PVC J cable to support transducer underwater connector. 0.6m), for Transmit, Receive Sign onnector (2 pins) (UMC2P) (onnectors are fixed with C er is listed in quote in detail. MIL3P) (Max. Diameter Φ19 hale Pins (XLR3P), (Max. Diar bie Connector is for uses u	N/A -190.6 $20 * \log \left\{ \left(1 + \frac{2\pi f_s C_c}{B} \right) / \sqrt{1} \right\}$ tension Cable. Cable is of 1 N/A -193.0 Valid for hydrophone withous e. Cable is of 100 pF/meter unit of Vrms. ble length if the cable has of H-3/8"): 2 x 3/8"-16 x 1.25' JWC-2P, FHUWC-3P.) 40.) or a complete list of Mounti acket. weight in air and water if in with Underwater Mateable al, and DC Power Supply. Max. Diameter Φ 21.5 to Φ Max. Diameter Φ 21.5 to Φ 0.6m unshielded cable. Uf to Φ 30 mm). meter Φ 20.2 mm). meter Φ 17 mm). nderwater. Other connect	N/A -184.0 $G^2 + (B + 2\pi f_s C_c)^2]/(G^2)$ 00 pF/meter roughly. N/A -195.0 ut preamplifier. roughly. wire leads or a non-waterp ' 316 SS Screw. ng Options and more deta the transducer has a mouter of the transduc	N/A -189.0 + B ²)} N/A -192.0 proof connector. proof connector. iils. anting part. Do not bend C2P). LSA-M. LSA-M. Facturers of underwater facturers of underwater pr dry uses and are not	



Benthowaye Instrument Inc.

Acoustical Solutions: SONAR, NDT/AE, HIFU. benthowave.com Revis

Revised on 2024/12/6

Size (Dyl) (mm);	Ф168 х 40	Ф168 х 40	Ф114 х 40	Ф114 х 40	Ф89 х 40		
Size WDXH (mm):	Actual length depends on Mounting Parts and/or Add-on Parts such as -IM, etc.						
	5.7 kg	5.7 kg	3.7 kg	2.7 kg	2.3 kg		
Weight in Air:	Weight is with 2 x 15m cables.						
	Actual weight depends on Mounting Parts, Cable Types and Length, and/or Add-on Parts such as -IM, etc.						
Operation Temperature:	-10 °C to +60 °C or 14 °F to 140 °F.						
Storage Temperature:	-20 °C to +60 °C or -4 °F to 140 °F.						
	BII6000 Bespoke Impedance Matching between transducers and power amplifiers. Order Separately as standalone devices or						
	append -IMxx Ω to the part number for integrating BII6000 into the transducer and specify impedance in Ω at fs. For example, BIIxxxx-						
Impedance Matching at fs:	IM50Ω: Bllxxxx transducer with built-in Impedance Matching unit as 50Ω load at fs.						
	Phase Angle $ \theta $ of Complex Impedance $\leq 20^{\circ}$ at fs.						
Power Amplifier:	BII5000 Power Amplifiers for SONAR, NDT, HIFU. Order Separately as standalone devices.						
WARNING: DANGER — HIGH VOLTAGE on wires. Wires shall be insulated for safety. DO NOT TOUCH THE WIRES BEFORE THE DRIVING SIGNAL IS SHUT DOWN. Cable							
shield must be grounded firmly for safety.							
for 50Ω BNC connector, it is	for 50Ω BNC connector, it is buyer's sole responsibility to make sure that the BNC shield of the signal source is firmly grounded for operating safety before hooking						
up transducer/hydrophone t	up transducer/hydrophone to the signal source. Coax with BNC is not intended for hand-held use at voltages above 30Vac/60Vdc.						

Wiring Information.

Transducer Wiring:	Shielded Cable	Coax, BNC.	UMC3P, Locking Sleeve: DLSA-M.	MIL3P	DIN3P	XLR3P	
Signal:	White or Red	Center Contact	Contact 2	Contact C or G	Pin 3	Pin 2	
Signal Common:	Black	Shield	Contact 1	Contact B	Pin 1	Pin 3	
Shielding and Grounding	Shield	Shield	Contact 3	Contact A	Pin 2	Pin 1	
Transducer Wiring. LPF: Low Primary Frequency, Cable Label "1"; HPF: High Primary Frequency, Cable Label "0".							
Wiring of Unshielded UMC2P (0.6m USC Cable originally coming from manufacturer of the connector, Fixed.).							
Cable:	WITE LEAUS WL	Locking Sleeve: DLSA-M.					
Signal	White	Contact 2					
Signal Common	Black	Contact 1					

How to Order

Part Number	- <u>ΙΜ50Ω</u>	-Mounting	-Cable Length	- <u>Cable</u>	- <u>Connector</u>	
BII7546-60, BII7546-110, BII7544-160,	Impedance Matching to 500	Defer to speed	in motory Two	Defer to choose		
BII7544-195, BII7543-295.	impedance Matching to 5002.	Refer to specs.	in meter x i wo.	Refer to specs.		
Example of Part Number: Description						
BII7546-60-BFM-FH-3/8"-15m-SC-WL	BII7546-60 transducer, Mounting: BFM-FH-3/8", 2x15m Shielded Cables, Wire Leads.					
BII7546-60-FH-15m-SC-WL	BII7546-60 transducer, Free Hanging, 2x15m Shielded Cable, Wire Leads.					
BII7546-60-IM50Ω-FH-15m-RG58-BNC	BII7546-60 transducer, Built-in Impedance Matching to 50Ω, Free Hanging, 2x15m RG58 Coax, BNC Male.					



System Block Diagram of Generate Sounds



Benthowaye Instrument Inc. benthowave.com

Acoustical Solutions: SONAR, NDT/AE, HIFU.

Revised on 2024/12/6





Directivity Pattern of Secondary Frequency Signal:





otan



Benthowaye Instrument Inc. benthowave.com

Acoustical Solutions: SONAR, NDT/AE, HIFU.

Revised on 2024/12/6

Page 5 of 5

Physical Size (Dimensional Unit: mm)



Two Cables

н



Top View

Physical Size (Dimensional Unit: mm)

Mounting Part:

EFMM.

Cable-out Layout for End-face Mounting for Multi-Channel (EFMM)



Physical Size (Dimensional Unit: mm)

Radiation Face

Mounting Part: Two Cables FH. ΦD D/2, Acoustic Center **Radiation Face** Front View

ΦD

Front View

Cable-out Layout for Free Hanging.

