

Vendors	Part No.	Size	SS/DS	Chip Brand	Timing	Voltage(V)	RAM Speed	Supported Speed with 3rd Gen AMD Ryzen™ Processors	DIMM socket support (Optional)	
									1 DIMM	2 DIMM
GALAXY	HOF4PXL4BST4400P19MF162C	2*8GB	SS	Samsung	19-19-19-39	1.4	4400	4400	•	•
GALAXY	HOF4CRL1CST4000M19SF162C	2*8GB	SS	Samsung	19-25-25-45	1.4	4000	4000	•	•
HyperX	HX440C19PB3AK2/16	2*8GB	SS	Samsung	19-21-21-42	1.35	4000	4000	•	•
CORSAIR	CMW32GX4M4K4000C19(Ver4.31)	4*8GB	SS	Samsung	19-23-23-45	1.35	4000	4000	•	•
G.SKILL	F4-3866C18Q-16GTZ	4*4GB	SS	Samsung	18-22-22-42	1.35	3866	3866	•	•
G.SKILL	F4-3866C18D-16GTZR	2*8GB	SS	Samsung	18-19-19-39	1.35	3866	3866	•	•
CORSAIR	CMD8GX4M2B3733C17 (Ver4.24)	2*4GB	SS	N/A	17-19-19-39	1.35	3733	3733	•	•
GALAXY	HOF4CALCS3600K17LD162C	2*8GB	SS	Samsung	17-18-18-38	1.35	3600	3600	•	•
CORSAIR	CMK16GX4M2B3600C18(Ver4.31)	2*8GB	SS	Samsung	18-19-19-39	1.35	3600	3600	•	•
GALAXY	HOF4CXL1BSR3600K17LD162C	2*8GB	SS	Samsung	17-18-18-38	1.35	3600	3600	•	•
HyperX	HX436C17PB3K4/32	4*8GB	SS	Samsung	17-18-18-39	1.35	3600	3600	•	•
G.SKILL	F4-3600C19D-16GSXK	2*8GB	SS	Hynix	19-19-19-39	1.35	3600	3600	•	•
G.SKILL	F4-3600C18D-16GTZR	2*8GB	SS	Hynix	18-22-22-42	1.35	3600	3600	•	•
PATRIOT	PVR416G360C6K	2*8GB	SS	Samsung	17-18-18-36	1.35	3600	3600	•	•
ADATA	AX4U360038G17-BR80	8*8GB	SS	Samsung	17-18-18-38	1.35	3600	3600	•	•
G.SKILL	F4-3600C19S-16GVRB	16GB	DS	Hynix	19-20-20-40	1.35	3600	3600	•	•
CORSAIR	CMW16GX4M2C3600C18 Ver4.31	2*8GB	SS	Samsung	18-19-19-39	1.35	3600	3600	•	•
CORSAIR	CMR16GX4M2C3600C18 Ver4.31	2*8GB	SS	Samsung	18-19-19-39	1.35	3600	3600	•	•
PATRIOT	PVLW416G360C6K	2*8GB	SS	Samsung	16-18-18-36	1.35	3600	3600	•	•
CORSAIR	CMD16GX4M2B3600C18 Ver4.31	2*8GB	SS	Samsung	18-19-19-39	1.35	3600	3600	•	•
CRUCIAL	BLS8G4D36BESBK.8FE	8GB	SS	Micron	16-18-18-38	1.35	3600	3600	•	•
Team	TF5D48G3600HC18EBK	8GB	SS	Hynix	18-20-20-44	1.35	3600	3600	•	•
Team	TXKD48G3600HC18ABK	8GB	SS	Samsung	19-20-20-39	1.35	3600	3600	•	•
G.SKILL	F4-3600C15D-16GTZ	2*8GB	SS	Samsung	15-15-15-35	1.35	3600	3600	•	•
OLOY	MD4U083618IADA	2*8GB	SS	Hynix	18-20-20-40	1.35	3600	3600	•	•
CORSAIR	CMT16GX4M2C3600C18(Ver4.31)	2*8GB	SS	Samsung	19-19-19-39	1.35	3600	3600	•	•
V-COLOR	TL48G36S8BNRGB18	8GB	SS	Hynix	18-19-19-39	1.35	3600	3600	•	•
ADATA	AX4U360038G17-DR80	8*8GB	SS	Samsung	17-18-18-38	1.35	3600	3600	•	•
CORSAIR	CMK16GX4M2Z3600C18 (Ver3.31)	2*8GB	SS	Micron	19-22-22-42	1.35	3600	3600	•	•
CORSAIR	CMW16GX4M2Z3600C18(Ver3.31)	2*8GB	SS	Micron	18-22-22-42	1.35	3600	3600	•	•
TIGO	TMKG8G3600C19	8GB	SS	Hynix	19-20-20-40	1.35	3600	3600	•	•
G.SKILL	F4-3600C18D-16GTRS	2*8GB	SS	Hynix	18-22-22-42	1.35	3600	3600	•	•
CORSAIR	CMW32GX4M4C3600C18 (Ver4.31)	2*8GB	SS	Samsung	18-19-19-39	1.35	3600	3600	•	•
G.SKILL	F4-3600C17Q-32GTZR	4*8GB	SS	Samsung	17-18-18-38	1.35	3600	3600	•	•
CORSAIR	CMD16GX4M4B3466C18 (Ver4.23)	4*4GB	SS	N/A	18-19-19-39	1.35	3400	3400	•	•
PATRIOT	PV48G340C6K	2*4GB	SS	Samsung	17-18-18-36	1.35	3400	3400	•	•
CORSAIR	CMU32GX4M4C3400C16R (Ver5.20)	4*8GB	SS	Samsung	16-18-18-36	1.35	3400	3400	•	•
CORSAIR	CMD32GX4M2B3466C16(Ver4.31)	2*16GB	DS	Samsung	16-18-18-36	1.35	3400	3400	•	•
G.SKILL	F4-3466C16Q2-64GTZ	8* 8GB	SS	N/A	16-18-18-38	1.35	3400	3400	•	•
HyperX	HX434C19FB2/8	8GB	SS	Micron Technology	19-23-23-42	1.2	3400	3400	•	•
HyperX	HX434C19FR2/8	8GB	SS	Micron Technology	19-23-23-42	1.2	3400	3400	•	•
HyperX	HX434C19FW2/8	8GB	SS	Micron Technology	19-23-23-42	1.2	3400	3400	•	•
G.SKILL	F4-3466C18D-16GTZRXB	2*8GB	SS	Hynix	18-22-22-42	1.35	3400	3400	•	•

CORSAIR	CMR32GX4M4C3333C16(Ver4.31)	4*8GB	SS	Samsung	16-18-18-35	1.35	3300	3300	•	•
PANRAM	PUD43200C164G4NJW	4* 4GB	SS	N/A	16-18-18-39	1.35	3200	3200	•	•
MUSHKIN	997202F	2*4GB	SS	N/A	15-15-15-36	1.2	3200	3200	•	•
APACER	78.BAGMD.AF20B	2*4GB	SS	Hynix	16-16-16-36	1.35	3200	3200	•	•
PATRIOT	PV48G320C6K	2*4GB	SS	N/A	16-16-16-36	1.35	3200	3200	•	•
HyperX	HX432C16PB3K4/32	4*8GB	SS	Hynix	16-18-18-36	1.35	3200	3200	•	•
CORSAIR	CMD16GX4M2B3200C16(Ver3.21)	16GB	DS	Samsung	16-18-18-36	1.35	3200	3200	•	•
CORSAIR	CMD32GX4M2C3200C16(Ver5.39)	2*16GB	DS	Hynix	16-18-18-36	1.35	3200	3200	•	•
Team	TF1D48G3200HC16CBK	8GB	SS	Hynix	16-18-18-38	1.35	3200	3200	•	•
Team	TF2D48G3200HC16CBK	8GB	SS	Hynix	16-18-18-38	1.35	3200	3200	•	•
CORSAIR	CMK16GX4M2B3200C16(Ver4.24)	2*8GB	DS	Samsung	16-18-18-36	1.35	3200	3200	•	•
CORSAIR	CMU16GX4M2C3200C16(Ver5.39)	2*8GB	SS	Hynix	16-18-18-36	1.35	3200	3200	•	•
HyperX	HX432C16PB3K2/16	2*8GB	SS	Hynix	16-18-18-36	1.35	3200	3200	•	•
Ramsta	R2DD4J32G3200	2*16GB	DS	Samsung	16-18-18-38	1.35	3200	3200	•	•
KINGMAX	GZOG43F-18SIGP	8GB	SS	N/A	16-18-18-38	1.35	3200	3200	•	•
V-COLOR	TL48G32S8CRGB16	8GB	SS	Samsung	16-18-18-38	1.35	3200	3200	•	•
Patriot	PVLW416G320C6K	2*8GB	SS	Samsung	16-18-18-36	1.35	3200	3200	•	•
silicon power	SP008GXLZU320BSB	8GB	SS	Samsung	16-18-18-38	1.35	3200	3200	•	•
Asgard	VMA45UG-MEC1U2BQ2	8GB	SS	Samsung	16-18-18-38	1.35	3200	3200	•	•
CRUCIAL	BLS8G4D32AESBK.8FE	8GB	SS	Micron	16-18-18-36	1.35	3200	3200	•	•
Klevv	IM48GU48A32-GIISMZ	2*8GB	DS	Samsung	16-18-18-38	1.35	3200	3200	•	•
Thermaltake	OD48G32S816-THC	8GB	SS	Hynix	16-18-18-38	1.35	3200	3200	•	•
GEIL	GLWS416GB3200C16ADC	8GB	SS	Samsung	16-18-18-36	1.35	3200	3200	•	•
Colorful	iGame DDR4 3200 8GB	8GB	SS	Samsung	16-18-18-38	1.35	3200	3200	•	•
G.SKILL	F4-3200C16D-16GTRS	2*8GB	SS	Hynix	16-18-18-38	1.35	3200	3200	•	•
TIGO	TMKG8G3200C16	8GB	SS	Samsung	16-18-18-38	1.35	3200	3200	•	•
CRUCIAL	BLS16G4D32AESB.M16FE	16GB	DS	Micron	16-18-18-36	1.35	3200	3200	•	•
AVEXIR	AVD4UZ130001604G-4COB	4*4GB	SS	N/A	15-15-15-36	1.35	3000	3000	•	•
AVEXIR	AVD4UZ130001608G-4COB	4*8GB	DS	N/A	15-15-15-36	1.35	3000	3000	•	•
HyperX	HX430C15SBK2/16	2*8GB	DS	N/A	15-15-15-36	1.35	3000	3000	•	•
CORSAIR	CMK16GX4M2B3000C15 (Ver4.24)	2*8GB	DS	Hynix	15-17-17-35	1.35	3000	3000	•	•
G.SKILL	F4-3000C15D-32GVR	2*16GB	DS	Samsung	15-15-15-35	1.35	3000	3000	•	•
CORSAIR	CMK64GX4M4B3000C15 (Ver4.31)	4*16GB	DS	Samsung	15-17-17-35	1.35	3000	3000	•	•
ADATA	AX4U300038G16-DBZ	8*8GB	DS	Hynix	16-18-18-36	1.35	3000	3000	•	•
ADATA	AX4U3000316G16-BGZ	16GB	DS	N/A	16-18-18-36	1.35	3000	3000	•	•
CORSAIR	CMD16GX4M4B3000C15(Ver4.24)	4GB	SS	Samsung	15-17-17-35	1.35	3000	3000	•	•
CORSAIR	CMU16GX4M2C3000C15 (Ver4.31)	8GB	SS	Samsung	15-17-17-35	1.35	3000	3000	•	•
CORSAIR	CMK16GX4M4B3000C15(Ver3.21)	4GB	SS	Micron	15-17-17-35	1.35	3000	3000	•	•
CORSAIR	CMU32GX4M4C3000C15 (Ver5.3)	4*8GB	DS	Hynix	15-17-17-35	1.35	3000	3000	•	•
GEIL	GFR416GB3000C15ADC	8GB	SS	Hynix	15-17-17-35	1.35	3000	3000	•	•
TEAM	TCD44G3000C16CBK	4GB	SS	Hynix	16-18-18-38	1.35	3000	3000	•	•
Klevv	IM4AGU88A30-FGGHMZ	16GB	DS	Hynix	16-16-16-36	1.35	3000	3000	•	•
Klevv	IM48GU88A30-FGGHMZ	8GB	SS	Hynix	16-16-16-36	1.35	3000	3000	•	•
Klevv	IM44GU48A30-FGGHAZ	4GB	SS	Hynix	16-16-16-36	1.35	3000	3000	•	•
Klevv	IM48GU88A30-FGGHMB	8GB	SS	Hynix	16-16-16-36	1.35	3000	3000	•	•
CORSAIR	CMD32GX4M4C3000C15(Ver5.30)	4* 8GB	SS	N/A	15-17-17-35	1.35	3000	3000	•	•

FORZA	NFMUD416E8-3000DH2A	16GB	DS	Hynix	15-17-17-35	1.35	3000	3000	•	•
FORZA	NFMUD480E8-3000DH2A	8GB	SS	Hynix	15-17-17-35	1.35	3000	3000	•	•
CORSAIR	CMR16GX4M2C3000C15(Ver4.31)	2* 8GB	SS	Hynix	15-17-17-35	1.35	3000	3000	•	•
CORSAIR	CMR32GX4M4C3000C15	4* 8GB	DS	Hynix	15-17-17-35	1.35	3000	3000	•	•
Team	TDRRD48G3000HC16CBK	8GB	DS	Samsung	16-18-18-38	1.35	3000	3000	•	•
Team	TDRGD48G3000HC16CBK	8GB	DS	Samsung	16-18-18-38	1.35	3000	3000	•	•
GALAXY	HOF DDR4-3000	2* 8GB	SS	Hynix	16-18-18-38	1.35	3000	3000	•	•
GeIL	GLR416GB3000C15ADC	8GB	SS	Hynix	15-17-17-35	1.35	3000	3000	•	•
G.SKILL	F4-3000C15S-16GVR	16GB	DS	Hynix	15-15-15-35	1.35	3000	3000	•	•
PATRIOT	PV432G300C6QK	4* 8GB	SS	N/A	16-16-16-36	1.35	3000	3000	•	•
HyperX	HX430C15PB3K4/32	4* 8GB	SS	Hynix	15-17-17-36	1.35	3000	3000	•	•
CRUCIAL	BLT8G4D30AETA.K16FE	8GB	DS	Samsung	15-16-16-35	1.35	3000	3000	•	•
PATRIOT	PVE416G300C6KBL	2* 8GB	SS	N/A	16-16-16-36	1.35	3000	3000	•	•
PATRIOT	PVE48G300C6KRD	2*4GB	SS	N/A	16-16-16-36	1.35	3000	3000	•	•
GALAXY	N/A	2*8GB	SS	Hynix	16-18-18-38	1.35	3000	3000	•	•
TIGO	TMKU8GF58-3000X	8GB	DS	Samsung	16-18-18-36	1.35	3000	3000	•	•
CORSAIR	CMK16GX4M2B3000C15R (Ver5.30)	8GB*2	SS	Hynix	15-17-17-35	1.35	3000	3000	•	•
CORSAIR	CMK16GX4M2B3000C15R (Ver3.32)	8GB*2	SS	N/A	15-17-17-35	1.35	3000	3000	•	•
CORSAIR	CM4X8GD3000C15U4-CN(Ver.5.39)	8GB	SS	Hynix	15-17-17-35	1.35	3000	3000	•	•
ADATA	AX4U300038G16-BRS	8*8GB	SS	Hynix	16-18-18-36	1.35	3000	3000	•	•
G.SKILL	F4-3000C16D-16GTZR	2*8GB	SS	N/A	16-18-18-38	1.35	3000	3000	•	•
APACER	ZD4-MO23000C16-08GAG	8GB	SS	Samsung	16-18-18-38	1.35	3000	3000	•	•
ADATA	AX4U300038G16-DRZ	8*8GB	SS	Nanya	16-18-18-36	1.35	3000	3000	•	•
CRUCIAL	BLT8G4D30BET4K.C8FD	8GB	SS	Micron	16-18-18-38	1.35	3000	3000	•	•
HyperX	HX430C15PB3/16-SP	16GB	DS	Hynix	15-17-17-36	1.35	3000	3000	•	•
HyperX	HX429C15PB3AK4/32	4*8GB	SS	Hynix	15-17-17-39	1.35	3000	3000	•	•
CORSAIR	CMK64GX4M4C3000C15(Ver5.32)	4*16GB	DS	Hynix	15-17-17-35	1.35	3000	3000	•	•
HYUNDAI	HYE8G30C16XY	8GB	SS	Samsung	16-18-18-38	1.35	3000	3000	•	•
Antec	AMD4UZ1240001508G-3S	8GB	SS	Samsung	16-18-18-36	1.35	3000	3000	•	•
INNO3D	RCX2-16G3000A	2*8GB	SS	Micron	16-18-18-36	1.35	3000	3000	•	•
HyperX	HX429C17FBK4/64	4*16GB	DS	Micron	17-19-19-39	1.2	3000	3000	•	•
HyperX	HX429C17FBK4/32	4*8GB	SS	Hynix	17-19-19-39	1.2	3000	3000	•	•
Antec	AMD4UZ130001608G-5S	8GB	SS	N/A	16-18-18-36	1.35	3000	3000	•	•
GLOWAY	TYP4U3000E16082C	8GB	SS	Samsung	16-18-18-38	1.35	3000	3000	•	•
CORSAIR	CMW16GX4M2C3000C15	2*8GB	SS	Hynix	16-17-17-35	1.35	3000	3000	•	•
OCPC	MMX3A16GD430C16	2*8GB	SS	Micron	16-18-18-36	1.35	3000	3000	•	•
CRUCIAL	BLT8G4D30BET4K	8GB	SS	Micron	16-18-18-38	1.35	3000	3000	•	•
CORSAIR	CMK64GX4M2D3000C16 Ver3.40	32GB	DS	Micron	16-20-20-38	1.35	3000	3000	•	•
HyperX	HX428C14PBK4/32	4*8GB	DS	Hynix	15-15-15-36	1.35	2800	2800	•	•
CORSAIR	CMK32GX4M4A2800C16	4*8GB	DS	N/A	16-18-18-36	1.2	2800	2800	•	•
HyperX	HX428C14SB2K4/32	4*8GB	DS	N/A	15-15-15-36	1.35	2800	2800	•	•
ADATA	AX4U2800316G16-SBF	16GB	DS	Hynix	17-16-16-36	1.2	2800	2800	•	•
CORSAIR	CMD32GX4M4A2800C16 (Ver5.20)	8GB	DS	Hynix	16-18-18-36	1.2	2800	2800	•	•
G.SKILL	F4-2800C16Q-32GVR	4*8GB	SS	Hynix	16-16-16-36	1.2	2800	2800	•	•
AVEXIR	AVD4UZ128001504G-4BZ1RR	4*4GB	SS	Samsung	15-15-15-35	1.35	2800	2800	•	•
AVEXIR	AVD4UZ128001508G-4BZ1RR	4*8GB	DS	Samsung	15-15-15-35	1.35	2800	2800	•	•

ADATA	AX4U2800W8G17-BRD	8GB	DS	N/A	17-17-17-36	1.2	2800	2800	•	•
G.SKILL	F4-2800C15Q-32GVR	4*8GB	SS	Hynix	15-15-15-35	1.25	2800	2800	•	•
crucial	BLS4G4D26BFSC.8FBR2	4GB	SS	N/A	16-18-18-38	1.2	2666	2666	•	•
CORSAIR	CMR16GX4M2A2666C16(Ver5.30)	2*8GB	SS	Hynix	16-18-18-35	1.2	2666	2666	•	•
HyperX	HX426C13PB3/8	4*8GB	SS	N/A	13-15-15-35	1.35	2666	2666	•	•
HyperX	HX426C13PB3K2/16	4*8GB	SS	N/A	13-15-15-35	1.35	2666	2666	•	•
HyperX	HX424C12PB3/8	4*8GB	SS	N/A	13-15-15-35	1.35	2666	2666	•	•
HyperX	HX424C12PB3K2/16	4*8GB	SS	N/A	13-15-15-35	1.35	2666	2666	•	•
HyperX	HX424C12PB3K4/32	4*8GB	SS	N/A	13-15-15-35	1.35	2666	2666	•	•
HyperX	HX426C13PB3/16	4*16GB	DS	Hynix	13-15-15-35	1.35	2666	2666	•	•
HyperX	HX426C13PB3K2/32	4*16GB	DS	Hynix	13-15-15-35	1.35	2666	2666	•	•
HyperX	HX424C12PB3K4/64	4*16GB	DS	Hynix	13-15-15-35	1.35	2666	2666	•	•
HyperX	HX424C12PB3/16	4*16GB	DS	Hynix	13-15-15-35	1.35	2666	2666	•	•
HyperX	HX424C12PB3K2/32	4*16GB	DS	Hynix	13-15-15-35	1.35	2666	2666	•	•
CRUCIAL	BLS8G4D26BFSC.8FBR	8GB	SS	Micron	16-18-18-38	1.2	2666	2666	•	•
TIGO	TMKG8G868-2666N	8GB	SS	N/A	19-19-19-43	1.2	2666	2666	•	•
PANRAM	W4U2666PS-16G	2*16GB	DS	Hynix	16-18-18-35	1.2	2666	2666	•	•
KINGSTON	KVR26N19S8/8-SP	8GB	SS	Micron	19-19-19-43	1.2	2666	2666	•	•
Micron	MTA16ATF2G64AZ-2G6E1	16GB	DS	Micron	19-19-19-43	1.2	2666	2666	•	•
HyperX	HX426C16FB2/8	8GB	SS	Hynix	16-18-18-39	1.2	2666	2666	•	•
Apacer	AU16GGB26CQYBGH	16GB	DS	Samsung	19-19-19-43	1.2	2666	2666	•	•
Apacer	AU08GGB26CQABGH	8GB	DS	Samsung	19-19-19-43	1.2	2666	2666	•	•
CRUCIAL	CT32G4DFD8266.16FB1	32GB	DS	Micron	19-19-19-43	1.2	2666	2666	•	•
TECLAST	TLD432G26P70	32GB	DS	Micron	19-19-19-43	1.2	2666	2666	•	•
CORSAIR	CMV32GX4M1A2666C18	32GB	DS	Micron	18-18-18-43	1.2	2666	2666	•	•
GLOWAY	TYP8U2400E17042C	8GB	SS	Micron	17-17-17-39	1.2	2400	2400	•	•
silicon power	SP008GBLFU240B02	8GB	SS	Hynix	17-17-17-39	1.2	2400	2400	•	•
GeIL	GLS48GB2400C16DC	4GB	SS	Micron	17-16-16-36	1.2	2400	2400	•	•
TIGO	TMKUFGF68-2400U	16GB	DS	Hynix	17-17-17-39	1.2	2400	2400	•	•
HYUNDAI	HYE4G24C17	4GB	SS	Hynix	17-17-17-39	1.2	2400	2400	•	•
MAXSUN	MSD44G24Q3	4GB	DS	Samsung	17-17-17-39	1.2	2400	2400	•	•
TECLAST	TLD44G24A30	4GB	DS	Micron	17-17-17-39	1.2	2400	2400	•	•
TECLAST	TLD48G24A30	8GB	SS	Micron	17-17-17-39	1.2	2400	2400	•	•
GEIL	DDR48GB2400C17QC	8GB	SS	Micron Technology	17-17-17-39	1.2	2400	2400	•	•
Ramsta	R2DD4J16G2400	2*8GB	SS	Micron Technology	16-16-16-36	1.2	2400	2400	•	•
Asgard	VML41UH-MIC1U22T1	16GB	SS	Micron	17-17-17-39	1.2	2400	2400	•	•
GALAXY	GAL4AXT1BMT2400D17KE161C	16GB	SS	Micron	17-17-17-39	1.2	2400	2400	•	•
CORSAIR	CMK64GX4M2A2400C16 Ver3.44	32GB	DS	Micron	16-16-16-39	1.2	2400	2400	•	•

Note:

For each DRAM channel (A,B), make sure to install the DRAM module to gray slot first.

- 1 DIMM: Supports one (1) module inserted into any gray slot as Single-channel memory configuration. Install the module into the A1 or B1 slot for better compatibility.
- 2 DIMMs: Supports two (2) modules inserted into one pair of gray slots as one pair of Dual-channel memory configuration. Install the modules into slots A1 and B1 for better compatibility.

1. Make sure to install the memory modules from the gray slots first.
2. The default DIMM frequency depends on its Serial Presence Detect (SPD), which is the standard way of accessing information from a memory module. Under the default state, some memory modules for overclocking

may operate at a lower frequency than the vendor-marked value.

3. Always install DIMMs with the same CAS latency. For optimal compatibility, we recommend that you install memory modules of the same version or date code (D/C) from the same vendor. Check with the retailer to get the correct memory modules.