

0.35 µm Process Family:

> XU035



0.35 Micron Modular Analog Mixed Signal Ultra High-Voltage Technology

DESCRIPTION

The XU035 series is X-FAB's 0.35-micron Modular 700V Ultra-High-Voltage (UHV) Technology. It is specifically engineered for AC LED driver and efficient AC/DC conversion applications. Based on a robust single poly, twin metal 0.35-micron process with a single 5V gate oxide, the platform features additional process modules such as a third UHV Metal, Zener Diode, Depletion MOS Startup Devices, MIM capacitors and high resistance polysilicon. A range of 20V and 40V medium voltage devices complete

of offering. With its low specific On-resistance UHV devices and the lowest mask count in the foundry industry, the XU035 platform is well suited for cost-effective consumer applications. Designers can rely on X-FAB's comprehensive design support including PDKs for all major design environments, precision spice models, analog and digital libraries, EasyZap Trimming solution and 2kV ESD support.

KEY FEATURES OVERVIEW

- 700V UHV low-side extended drain NMOS/PMOS process
- 0.35 µm single 5V gate oxide CMOS technology optimized for high volume consumer applications on 8" float zone wafers
- Industry leading lowest mask count from as low as 13 masks
- Competitive 700V RDSON of 14 Ωmm²
- 20V and 40V medium voltage transistors
- Wide spectrum of analog passive devices, e.g. UHV resistors, MOS and MIM capacitors and protection diodes
- Optional third standard or UHV power metals
- Spectre and HSpice spice models
- 3.3V & 5V low power junction isolated standard cells library
- 2kV HBM ESD support
- EasyZap IP for trimming
- Cadence, Mentor, Synopsys and Tanner PDK support
- Operating Conditions: Tj = -40°C ... +125°C

APPLICATIONS

- AC/DC Conversion Applications
- AC LED Lighting
- Mixed-signal embedded systems / systems-on-chip (SOC)
- Power management ICs

QUALITY ASSURANCE

X-FAB spends a lot of effort to improve the product quality and reliability and to provide competent support to the customers. This is maintained by the direct and flexible customer interface, the reliable manufacturing process and complex test and evaluation conceptions, all of them guided by

strict quality improvement procedures developed by X-FAB. This comprehensive, proprietary quality improvement system has been certified to fulfill the requirements of the ISO 9001, ISO TS 16949 and other standards.

DELIVERABLES

- PCM tested wafers
- Optional engineering services: Multi Project Wafer (MPW) and Multi Layer Mask Service (MLM)
- Optional design services: feasibility studies, Place & Route, synthesis, custom block development

PRIMITIVE DEVICES

- NMOS/PMOS transistors
- Bipolar transistors
- Diodes
- Capacitors
- Resistors
- HV DMOS transistors

XU035 PROCESS MODULES

CORE Module	Remarks	Mask No.
MOSS	Core MOS module	13

FEOL Module	Remarks	Mask No.
DEPL	Depletion NMOS module	1
HRPOLY	High resistance polysilicon 1 module	1
XRPOLY	Very high resistance polysilicon 1 module	1
ESD	UHV MOS ESD module	1
ZENER	Zener diode module	1
MOS400	UHV 400V MOS devices	0
MOS700	UHV 700V MOS devices	0

BEOL Module	Remarks	Mask No.
MIM	MIM capacitor module	1
MIMA	MIM capacitor module	1
METAL3	Metal 3 module	2
UHVMET	Ultra HV metal module	2

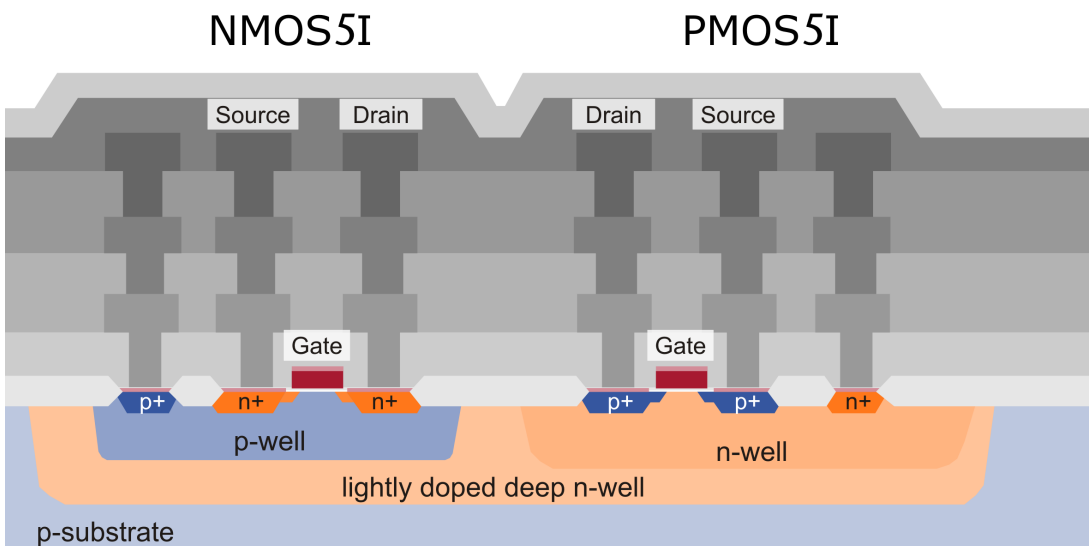
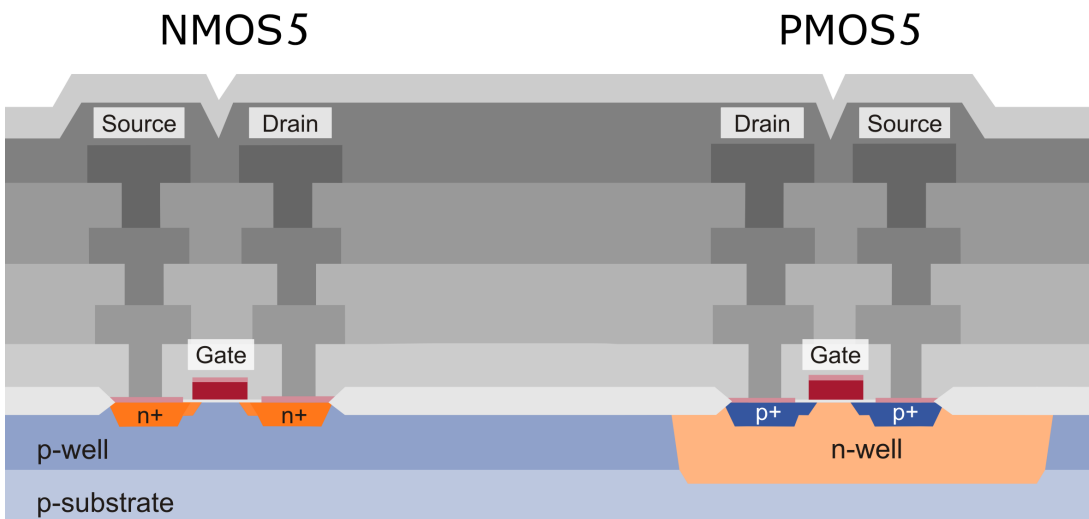
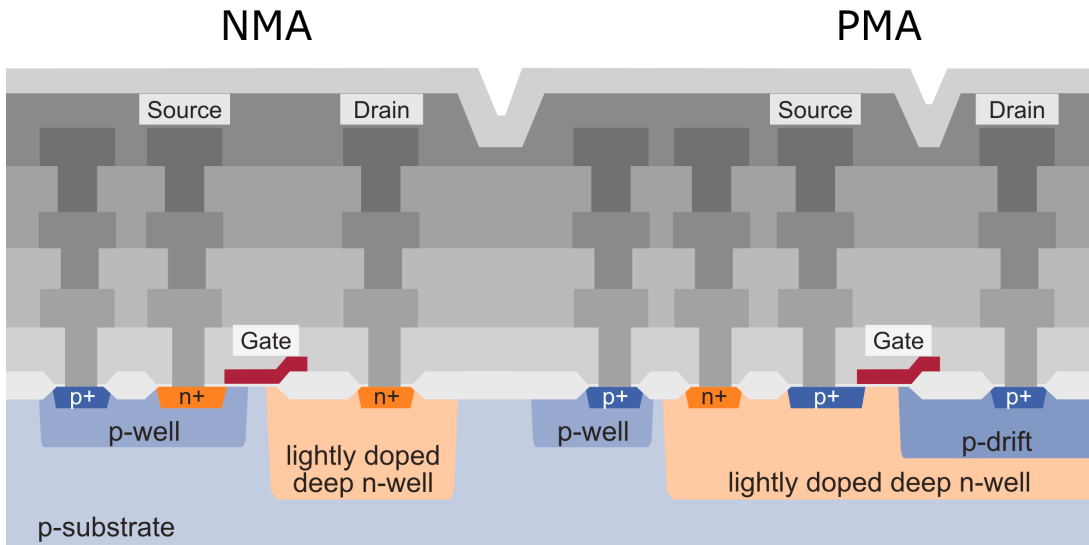
XU035 RESTRICTIONS FOR MODULE COMBINATIONS

Module name	Use of the module also requires use of the following module(s)	Use of the module is not available with the use of the following module(s)
XRPOLY	HRPOLY	
MOS400	UHVMET	
MIM	METAL3	MIMA, UHVMET
MIMA		MIM, METAL3
METAL3		UHVMET
UHVMET		METAL3

XU035 BASIC DESIGN RULES

Mask	width [µm]	Spacing [µm]
N-well	1.6	1.0
Active Area	0.5	0.6
Poly-silicon Gate/Resistor	0.35	0.45
Contact	0.4	0.4
Metal 1, Via 1, Via 2	0.5	0.45
Metal 2/3	0.6	0.5 / 0.6
UHV Metal	3.0	2.5

XU035 SCHEMATIC CROSS SECTIONS



XU035 PROCESS FLOW

Core Module	Additional Modules	
Zero Layer		
DW Implant		
Active Area		
N-well		
P-well		
	ESD Implant	ESD
P-Drift		
	ND Implant	DEPL
	High Res. Poly	HRPOLY
Poly 1		
	Sub-surface Implant	ZENER
N-LDD Implant		
P-LDD Implant		
N+ implant		
P+ Implant		
	Very High Res. Poly	XRPOLY
Contact		
	MIMA Capacitor	MIMA (Not with MATEL3)
Metal 1		
Via 1		
	MIM Capacitor	MIM (Not with UHVMET)
Metal 2		
	Via 2	METAL3 (Not with UHVMET)
	Metal 3	
	Via HV	
	Metal UHV	UHVMET (Not with MATEL3)
Passivation		
Back side grinding (on customer request)		
		mask steps

Active Devices

XU035 LOW VOLTAGE TRANSISTORS

Device	Name	Available with module	VT [V]	IDS [μA/μm]	BVDS [V]	Max. VDS [V]	Max. VGS[V]
5V NMOS	nmos5	MOSS	0.94	425	> 7	5.5	5.5
5V PMOS	pmos5	MOSS	0.94	195	> 7	5.5	5.5
5V isolated NMOS	nmos5i	MOSS	0.88	435	> 7	5.5	5.5
5V isolated PMOS	pmos5i	MOSS	1.03	185	> 7	5.5	5.5

Active Devices (Continued)

XU035 HIGH VOLTAGE TRANSISTORS									
Device	Name	Available w/ module	VT [V]	IDS [μ A/ μ m]	RON [k Ω · μ m]	RON*area [m Ω ·mm ²]	BVDSS [V]	Max. VDS[V]	Max VGS[V]
20V drain NMOS	nma	MOSS	0.86	345	7.6	32	> 27	20	5.5
20V drain PMOS	pma	MOSS	1.01	140	30	143	> 30	20	5.5
20V d & s PMOS	pmma	MOSS	1.12	45	65	480	> 30	20	5.5
20V drain NDMOS	ndma	MOSS	0.84	360	7.3	31	> 27	20	5.5
40V drain PMOS	pmb	MOSS	1.12	75	65	460	> 50	40	5.5
40V NDMOS	ndmb	MOSS	0.86	185	17.5	120	> 50	40	5.5

XU035 ULTRA HIGH VOLTAGE TRANSISTORS									
Device	Name	Available w/ module	VT [V]	IDS [μ A/ μ m]	RON [k Ω · μ m]	RON*A [Ω ·mm ²]	BVDSS [V]	Max. VDS[V]	Max VGS[V]
400V NDMOS	ndrv	MOS400 +UHVMET	0.79	108	100	5	> 460	400	5.5
400V NDMOS ESD	ndre	MOS400 +ESD +UHVMET	0.79	108	100	5	> 460	400	5.5
700V NMOS	nuv	MOS700 +UHVMET	0.79	61	190	15	> 720	620	5.5
700V PMOS	puv	MOS700 +UHVMET	1.07	14	710	64	> 720	600	5.5
700V NMOS	nuvp*	MOS700	0.79	57	186	14.7	> 750	650	5.5
700V NDMOS	nduv	MOS700 +UHVMET	0.77	70	175	14	> 720	620	5.5
700V NDMOS ESD	ndue	MOS700 +ESD +UHVMET	0.77	70	170	13.6	> 720	620	5.5
700V NDMOS	nduvp*	MOS700	0.77	65	165	13.2	> 750	650	5.5
700V NDMOS ESD	nduep*	MOS700 +ESD	0.77	67	165	13.2	> 750	650	5.5
700V NMOS meander	nduvf	MOS700	0.74	51	240	19.3	> 720	600	5.5
700V NDMOS mean- der ESD	nduef	MOS700 +ESD	0.74	51	240	19.3	> 720	620	5.5

* with drain pad inside

XU035 DEPLETION TRANSISTORS									
Device	Name	Available with module	VT [V]	IDS [μ A/ μ m]	RON [k Ω · μ m]	RON*A [Ω ·mm ²]	BVDSS [V]	Max. VDS [V]	Max. VGS [V]
40V Depl NDMOS	ndmbd	DEPL	0.86	210	15	0.105	> 50	40	5.5
400V Depl NDMOS	ndrvd	DEPL +UHVMET +MOS400	1.04	111	97	4.9	> 460	400	5.5
400V Depl NDMOS ESD	ndred	DEPL +ESD +UH- VMET +MOS400	1.02	110	97	4.9	> 460	400	5.5
700V Depl NDMOS	nduvd	DEPL +UHVMET +MOS700	1.0	72	170	13.6	> 720	620	5.5
700V Depl NDMOS	nduudp	DEPL +MOS700	1.0	67	165	13.2	> 750	650	5.5
700V Depl NDMOS ESD	ndued	DEPL+ESD +UHV- MET +MOS700	0.96	72	170	13.6	> 720	620	5.5
700V Depl NDMOS ESD	nduedp	DEPL+ESD +MOS700	0.96	68	165	13.2	> 750	650	5.5

Active Devices (Continued)

XU035 BIPOLAR TRANSISTORS

Device	Name	Available	BETA	VA [V]	BVCEO [V]	VBE [mV]	Max. VCE [V]
Vertical PNP	qp1, qp2, qp3, qp4 *	MOSS	10	260		685	5
Isolated vertical PNP	qnvc	MOSS	65	82	> 7	647	5.5

* Vertical PNP bipolar transistor with emitter size 8 μ m² / 155 μ m² / 12.5 μ m² / 100 μ m² respectively

Passive Devices

XU035 DIFFUSION & METAL RESISTORS

Device	Name	Available with module	RS [Ω/\square]	Thickness/junc. depth [μ m]	Temp. Co-eff. [$10^{-3}/K$]	Max VTB [V]
P+ diff in Nwell	rdp, rdp_io*	MOSS	140	0.21	1.6	6
P+ diff in Nwell /LDD Nwell	rdplw, rdplw_io*	MOSS	140	0.21	1.6	6
N+ diff in Pwell	rdn, rdn_io*	MOSS	85	0.17	1.6	6
N+ diff in Pwell /LDD Nwell	rdnlw, rdnlw_io*	MOSS	85	0.17	1.6	6
N-well	rw	MOSS	1140	1.7	3.9	6
Metal 1	rm1	MOSS	0.090	0.58	3.4	100
Metal 2	rm2t	MOSS	0.045	1.0	3.4	100
Metal 2	rm2	UHVMET, METAL3	0.090	0.58	3.4	100
Metal 3	rm3t	METAL3	0.045	1.0	3.4	100
UHV metal	rmhv	UHVMET	0.030	1.3	3.4	650

* This device should be used only as an ESD protection resistor in IO-cells

XU035 POLY RESISTORS

Device	Name	Available with module	RS [Ω/\square]	Temp. Coeff. [$10^{-3}/K$]	Max VTB [V]
N+ HRES polysilicon 1	rnp1	HRPOLY	950	-2.8	100
P+ HRES polysilicon 1	rpp1	HRPOLY	425	-0.51	100
Polysilicon 1	rp1	MOSS	43	0.8	100
Very high value polysilicon	rhp1	XRPOLY	11,000	-5.33	100

XU035 CAPACITORS

Device	Name	Available with module	Area Cap [fF/ μ m ²]	BV [V]	Perimeter Cap. [fF/ μ m]	Max. VTB [V]
Poly/M1/M2	csw	MOSS	120 (fF)			100
Poly/M1/M2/M3 finger	csandwtf	METAL3	275 (fF)			100
Poly - N-depletion MOS	cpd5	DEPL	2.1	> 10	0.18	5.5 (max. VGB)
Isolated Poly1/NDepl MOS	cpd5i, cpd5ih, cpd5iu	DEPL	2.1	> 10	0.18	5.5 (max. VGB)
Metal2/Metal3 MIM	cmm, cmm2	MIM	1.25	> 20	0.111	100
Metal1/Metal2 MIM	cmma, cmma2	MIMA	1.25	> 20	0.111	100

Passive Devices (Continued)

XU035 DIFFUSION DIODES						
Device	Name	Available with module	BV [V]	Area junc. cap. [fF/μm ²]	Sidewall Cap. [fF/μm]	Max VCC [V]
N+ diff /Pwell	dn	MOS5	> 8	0.76	0.29	6
P+ diff /Nwell	dp	MOS5	> 8	1.03	0.23	6
P+ diff /LDD Nwell	dplw	MOS5	> 8	0.33	0.21	6
Nwell /Psub	dw	MOS5	> 8	0.05	0.65	6
Nwell /Psub	dwh	MOS5	> 15	0.04	0.32	10
Pwell /LDD Nwell	dwplw	MOS5	> 14	0.27	0.31	10
Pwell / LDD Nwell	dwplwh	MOS5	> 25	0.27	0.31	20
LDD Nwell /Psub	dlw	MOS5	> 14	0.03	0.41	10
LDD Nwell /Psub	dlwh	MOS5	> 50	0.03	0.41	40
LDD Nwell /Psub	dlwu	MOS5	> 750	0.03	0.41	650

XU035 ZENER DIODE						
Device	Name	Avaiable with module	Rz [Ω]	Temp Coeff [mV/K]	Vreverse [V]	Max Ireverse [mA/μm ²]
5.8V Zener	dzeg, dzegh, dzegu	ZENER	600	2	5.8	0.1

XU035 SCHOTTKY DIODES						
Device	Name	Available with module	Vforward [V]	Leakage Current [nA]	BV [V]	Max. VCC [V]
Schottky	dsd	MOS5	0.21	17	> 22	18

OTP & LOGIC LIBRARY

XU035 ZENER ZAP DIODE				
Device	Name	Avaiable with module	Vreverse (unzap [V] /Zapped [log(V)])	Max Iread [mA]
Zener Zap	dzap *	MOS5	4 / -1.8	0.05

* The zener zap diode, dzap is only intended as a programmable element.

XU035 EASYZAP OTP MACRO	
Parameter	Value
Modules	MOS5
Programming / Read/write voltage (V)	9.5V±0.2 / 3 to 5.5
Configurations (bits)	2 to 128 bit
32bit Sample Macro Size	0.055 mm ²
Programming pad in I/O Ring	Size = 0.041 mm ²
Temp. range (read / programming) in °C	-40 to +125 / 25±5

XU035 LOGIC LIBRARY			
Device	Library feature	Voltage range	Application benefits
D_CELLSL_J15V	Low power, junction isolated	5V	Min. power consumption, min. noise

LOGIC LIBRARIES

XU035 I/O LIBRARY

Device	Library Feature	V _{CORE} *	V _{IO} *	ESD Level	Application benefits
IO_CELLS_5V	Standard, V _{CORE} ≤ V _{IO} multi supply voltage	5.0V 3.3V 3.3V	5.0V 5.0V 3.3V	4kV HBM	Pad limited
IO_CELLS_F5V	Standard, V _{CORE} ≤ V _{IO} multi supply voltage	5.0V 3.3V 3.3V	5.0V 5.0V 3.3V	2kV HBM	Core limited

* Please refer to the library databook for details about available PVT ranges

XH035 HV CELLS

Device	Library Feature	Voltage Range	ESD Level	Application benefits
HV_CELLS	Special LV I/O, operating voltage specific HV ESD protection cells	LV, 12V-40V	3kV-8kV HBM	Customized I/O Design

ANALOG LIBRARIES

XU035 GENERAL ANALOG LIBRARY

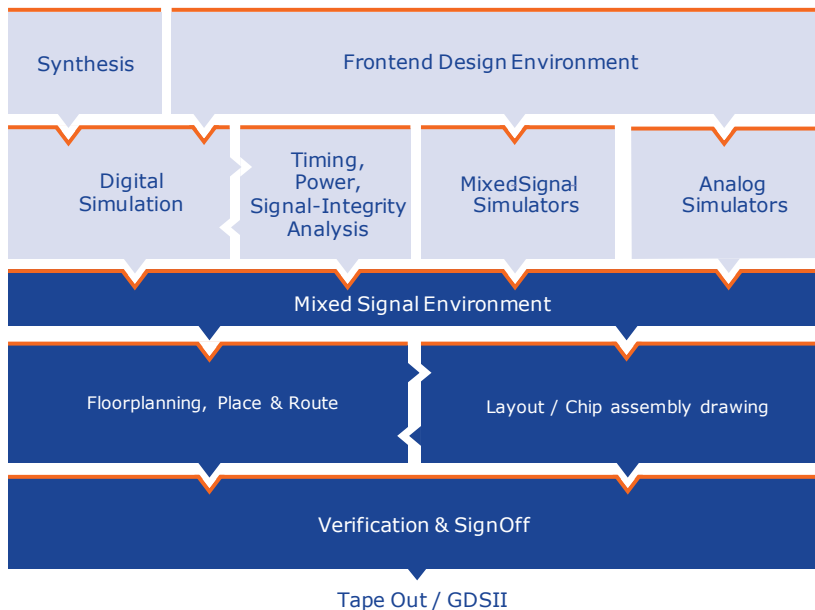
Library	Cell Name	Operating conditions	Required module
Operational Amplifiers	aopac01ji	VDD: 3.5V to 5.5V; T: -40...125°C	MOSS, METAL3, MIM, HRPOLY
Operational Amplifiers	aopac02ji	VDD: 3.5V to 5.5V; T: -40...125°C	MOSS, METAL3, MIM
Bandgap	abgpc01ji	VDD: 2.5V to 5.5V; T: -40...125°C	MOSS, METAL3, MIM, HRPOLY
Bias Cell	acsoc01ji	VDD: 3.5V to 5.5V; T: -40...125°C	MOSS, METAL3, MIM, HRPOLY

XU035 APPLICATION SPECIFIC ANALOG LIBRARY

Library	Cell Name	Operating conditions	Required module
XSMPS Supply Regulation	xpshvbc01_5V	UHV power supply cell	MOSS, HRPOLY, DEPL, UHVMET
	xpslstc01_5V	Linear regulator 5V	MOSS, HRPOLY
	xpsporc01_5V	Power on Reset with hysteresis	MOSS, HRPOLY, DEPL
XSMPS Reference and Current formers	abgpc01(/2/3)_1v8	Bandgap voltage reference: 2.25V, 2.5V, 2.55V	MOSS, HRPOLY
	xpsbgbc01_5V	Multi-voltage reference buffer	MOSS, HRPOLY
	xpscsc01_5V	General purpose current source	MOSS, HRPOLY
XSMPS Oscillators and other core cells	xpspwmc01_5V	40kHz saw oscillator	MOSS, HRPOLY
	xpscscmpc01_5V	Comparator	MOSS
	xpsswdc01_5V	Output Buffer	MOSS
XSMPS Protection	xpsopac01_5V	Error Amplifier	MOSS
	xpscsmc01_5V	Current sense	MOSS, HRPOLY
	xpsolpc01_5V	Over-load protection	MOSS, HRPOLY
	xpstmpc01_5V	Over-temperature detector	MOSS, HRPOLY

Operating conditions: VDD: 4.5V to 5.5V; T: -40...125°C.

XU035 SUPPORTED EDA TOOLS



Note: Diagram shows overview of reference flow at X-FAB. Detailed information of supported EDA tools for major vendors like Cadence, Mentor and Synopsys can be found on X-FAB's online technical information center X-TIC.

X-FAB'S IC DEVELOPMENT KIT "THEKIT"

The X-FAB IC Development Kit is a complete solution for easy access to X-FAB technologies. TheKit is the best interface between standard CAE tools and X-FAB's processes and libraries. TheKit is available in two versions, the Master Kit and the Master Kit Plus. Both versions contain documentation, a set of software programs and utilities, digital and I/O libraries

which contain full front-end and back-end information for the development of digital, analog and mixed signal circuits. Tutorials and application notes are included as well. The Master Kit Plus additionally provides a set of general purpose analog functions mentioned in section "Analog Library Cells" and is subject to a particular license.

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