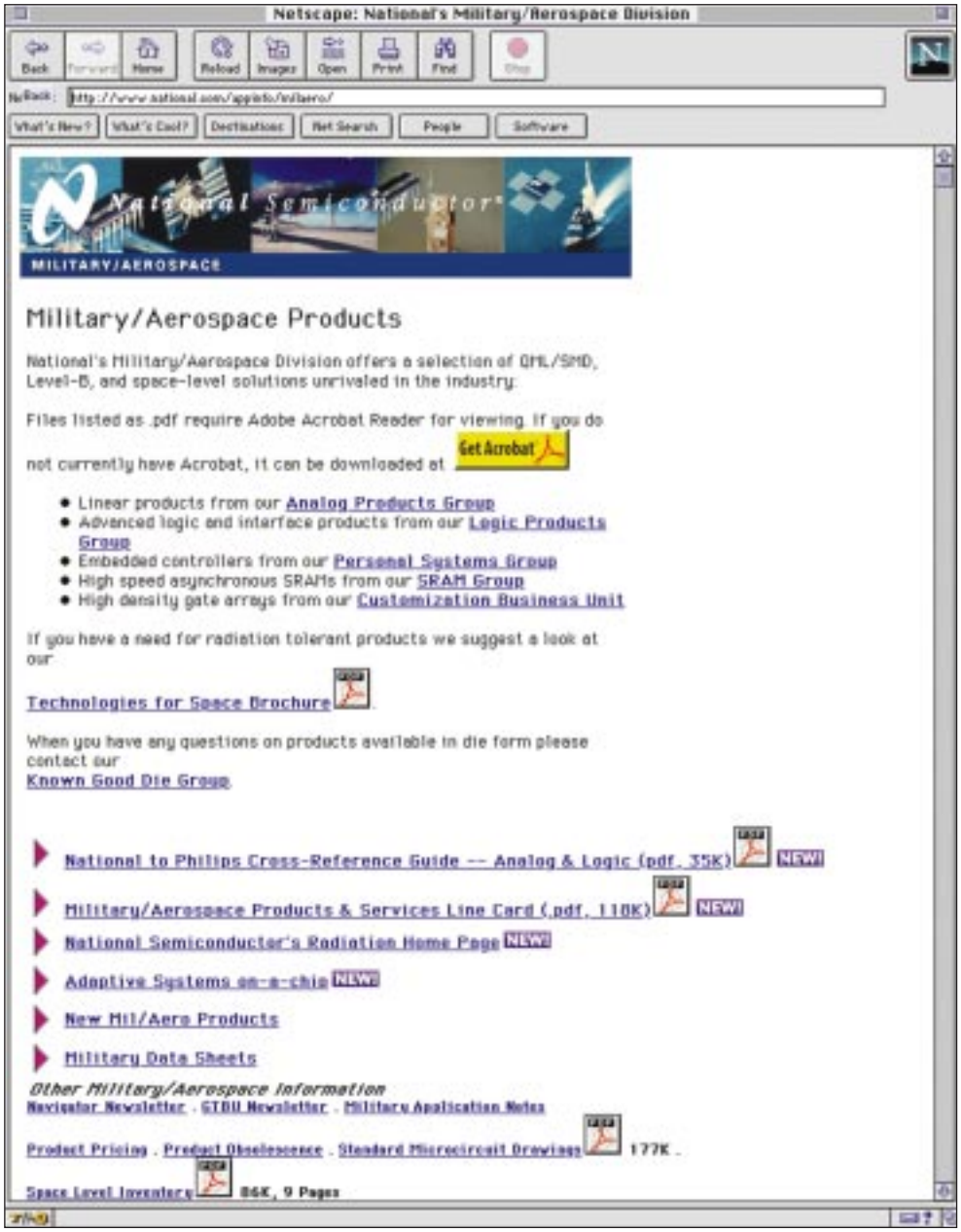
National Semiconductor

Military/Aerospace Division
Product Line Card
1997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MILITARY/AEROSPACE
Military/Aerospace Products
National's Military/Aerospace Division offers a selection of QML/SMD, Level-B, and space-level solutions unrivaled in the industry.
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Linear products from our Analog Products Group
Advanced logic and interface products from our Logic Products Group
Embedded controllers from our Personal Systems Group
High speed asynchronous SRAMs from our SRAM Group
High density gate arrays from our Customization Business Unit
If you have a need for radiation tolerant products we suggest a look at our
Technologies for Space Brochure
When you have any questions on products available in die form please contact our
Known Good Die Group
National to Philips Cross-Reference Guide -- Analog & Logic (pdf, 35K) NEW!
Military/Aerospace Products & Services Line Card (pdf, 110K) NEW!
National Semiconductor's Radiation Home Page NEW!
Adaptive Systems on-a-chip NEW!
New Mil/Aero Products
Military Data Sheets
Other Military/Aerospace Information
Navigator Newsletter . GTBU Newsletter . Military Application Notes
Product Pricing . Product Obsolescence . Standard Microcircuit Drawings 177K .
Space Level Inventory 86K, 9 Pages

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At National Semiconductor®, it's about innovation.

One of the largest suppliers of IC products for high reliability applications, we've provided analog and mixed-signal engineering for the Military/Aerospace market for more than 30 years. Our expertise in system design and integration is creating innovative solutions for space, radar, communications, and other applications. For fast, effective product design, development, and delivery, National provides knowledge in systems integration and design, as well as organizational and partnership strategies – whether the product you need comes off-the-shelf or is customized for your environment and application.

National continually evaluates and develops new products for your applications. We are expanding our space and RHA portfolio, introducing low-voltage analog, interface, and logic components; developing new SRAM products; and qualifying PLLs for the wireless market. If you need a full military customizable system-on-a-chip solution, that's available, too. Or for bare die or fully tested Known Good Die, check out our offerings across the National portfolio. We can support your upgrade requirements with new products, and are also committed to your existing designs with long-term product support.

It's all included in this guide. Here are the products we offer, qualification levels, and packages as well as available process flows, radiation testing, and other information that can support your design. For additional information, please contact your National sales representative.

Process Flow	Description
Space-Level Systems	
QML V	QML (DSCC Qualified Manufacturers List) product processed to MIL-PRF-38535 for space-level applications.
QML V "R"	QML (DSCC Qualified Manufacturers List) product processed to MIL-PRF-38535 with guaranteed RHA radiation assurance to 100 krads(Si).
JAN Class S	QPL (DSSC Qualified Products List) products processed to MIL-PRF-38535 Appendix B for space-level applications.
JAN Class S "R"	QPL (DSSC Qualified Products List) products processed to MIL-PRF-38535 Appendix B Level S with guaranteed RHA radiation assurance to 100 krads(Si).
MLS	Microcircuit Line for Space — Non-JAN products processed to space flow.
Naval/Air/Ground Systems	
QML Q	QML (DSCC Qualified Manufacturers List) product processed to MIL-PRF-38535 for ground applications.
JAN Class B	QPL (DSSC Qualified Products List) products processed to MIL-PRF-38535 Appendix A, Level B.
JAN Class B "R"	QPL (DSSC Qualified Products List) products processed to MIL-PRF-38535 Appendix A Level B with guaranteed RHA radiation assurance to 100 krads(Si).
SMD	Standard Microcircuit Drawing tactical-level products processed to QML Level Q with electrical specifications controlled by DSSC. (National's SMD products that include an M or Q in the SMD part number are controlled by and fully compliant with MIL-PRF-38535 QML Q.)
/883	Products processed to MIL-STD-883 Level B for military with electrical specifications controlled by manufacturer.
-MCR (also -MC1)	Commercial products processed to the military assembly flow (Military Commercial Room).
-MPC	Military plastic parts processed to commercial assembly and test flows.
Commercial-Grade Systems	
DC, HC	Hermetic commercially processed product
Other Services	
KGD	Known Good Die
Radiation Testing	National Semiconductor has a large radiation-tested product offering. Military and Aerospace devices which are not currently offered as radiation-tolerant product may be procured with Total Dose Testing performed as an add-on option. Radiation test reports performed by National are available on many device types upon request.

Die Process Flow Charts

As system designers search for ways to derive higher performance – with reduced power consumption, size and weight – from their circuit designs, they are turning to suppliers of bare die and known good die for cost-effective solutions.

Die product technology options from National Semiconductor include:

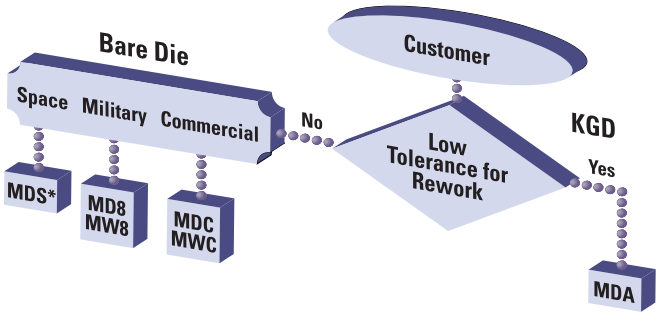
- Analog
- Custom ASICs
- Interface
- Logic
- Memory
- Microcontrollers
- SCAN boundary test (IEEE 1149.1)
- WAN/LAN
- Wireless

Although National's Die Products Program emphasizes processing flexibility, we strive to make our customers' decisions about selecting die products as simple as possible. National offers two broad categories of die products based on the level of assurance which they provide – Bare Die and Known Good Die.

Bare Die (MDC, MD8, MDS Device Suffixes)

Nearly all National products are available as bare die. This process flow is designed for products and technologies that meet these criteria:

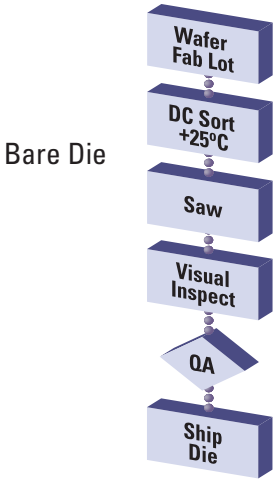
- Products with well characterized DC and AC parametrics over temperature
- Reliable and well-documented manufacturing processes
- MDC and MD8 die are sold in whole wafer multiples, one wafer minimum.
- S-level (MDS) die are sold in 50-piece minimums.

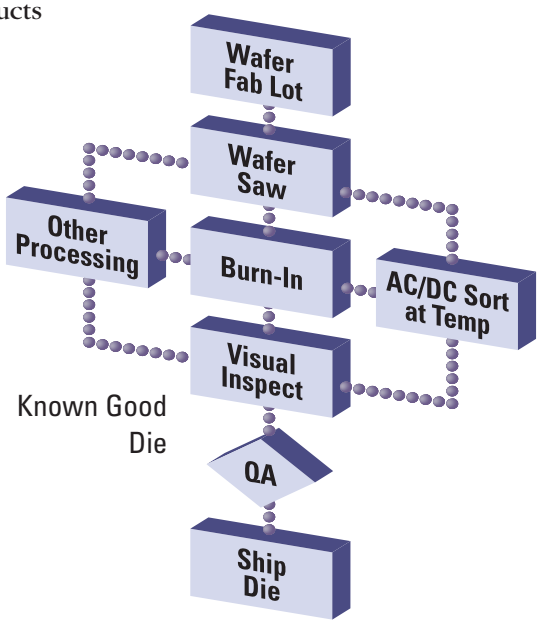


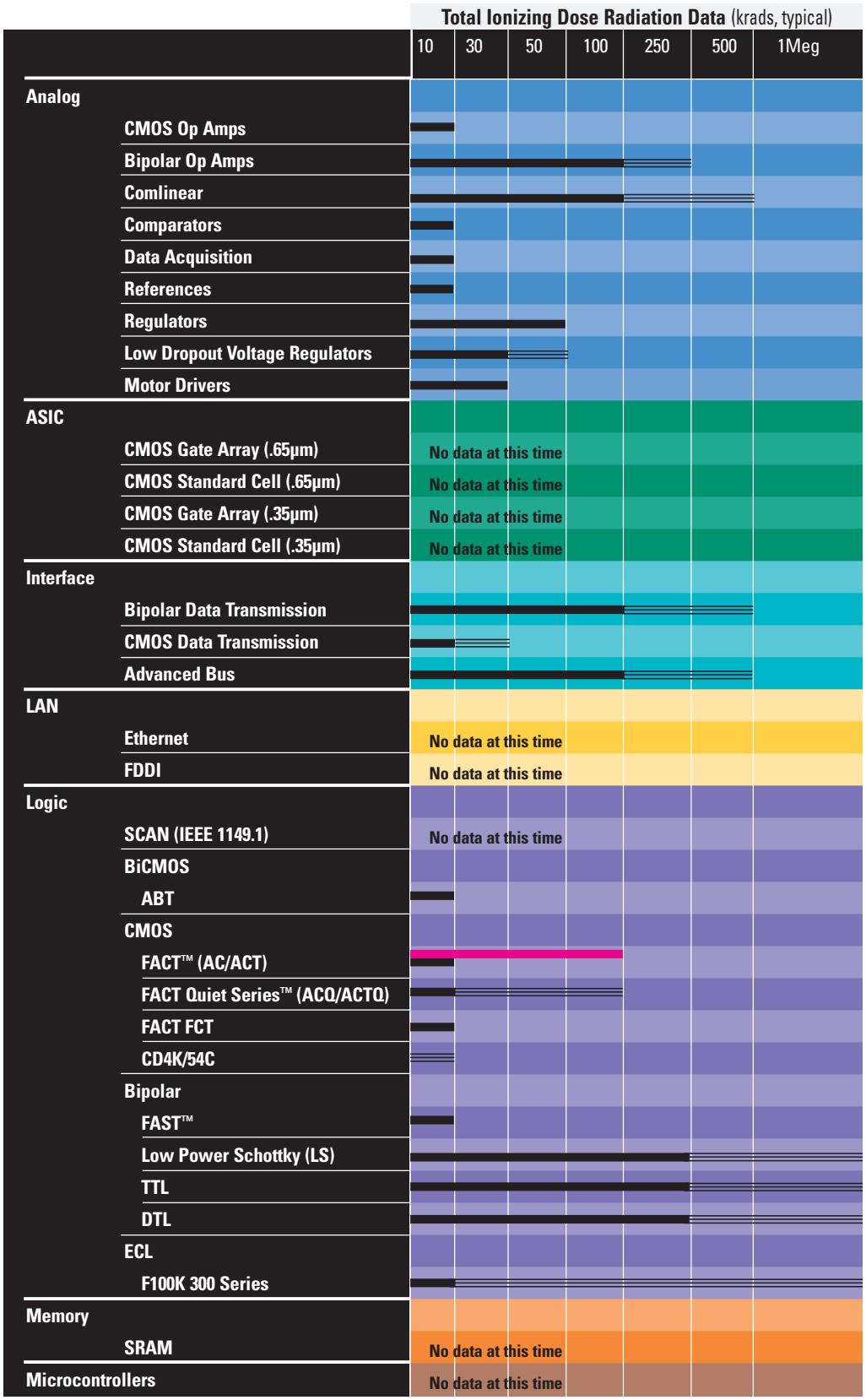
Known Good Die (MDA Device Suffix)

Selected National die products are offered fully guaranteed to the KGD datasheets. These devices have received additional screening to ensure that they will meet the die products datasheets. This flow is recommended for newer products as well as for those with variable yield history. Products in this category meet these criteria:

- Technologies with newly established manufacturing processes
- Recently characterized temperature performance
- Variable temperature performance
- KGD is sold in 100-piece minimums for standard products
- $5,000 to $15,000 NRE may apply for non-standard products







* FACT products qualified as JAN S "R"/QML V "R", JAN B "R"; meets 100krads

Radiation tolerance varies by function and wafer lot

FACT RHA products qualified to 100krads ("R")

Test Methodology

1. All wafers are fabricated according to S-Level or equivalent specifications. This includes SEM (Scanning Electron Microscope) inspection of two metalization steps and wafer lot acceptance data.

2. Each wafer selected for radiation testing is classified as a "wafer lot" and is stored in a wafer bank for radiation-hardened product.

3. Total Dose testing is performed at room temperature (+25˚C) in full accordance with MIL-STD-883, Method 1019.4.

4. The twelve (minimum per wafer) radiation test die subjected to testing are chosen just beyond the RHA area. This area is defined as that part of the wafer enclosed by 2/3 of the wafer's radial dimension as drawn from the center toward the wafer edge. Die within this area are used if the customer invokes this JAN requirement.

5. Sample die are assembled and tested to full JAN or customer specifications prior to radiation testing.

6. Every product type is qualified under worst-case bias conditions for Total Dose radiation response on a step-stress irradiation basis, e.g., at radiation interval levels of 3 krad(Si), 10 krad(Si), etc., up to 100 krad(Si) or to functional failure.

7. Radiation characterization includes determining the Total Dose level where parametric and functionality failures occur. The lowest Total Dose failure level is dictated by whichever failure occurs first – parametric or functionality. The highest passing level is dictated by no parametric or functional failures.

8. Each completed wafer that is accepted for radiation-qualified products is die-banked for future use.

9. A customer may purchase a whole or partial wafer lot. If the entire lot is purchased, the radiation-qualified wafer is die banked pending the customer's release of the remaining die or until all usable die from that lot are delivered. If only a small quantity of die is purchased from a radiation-qualified wafer lot, the die balance remains available to other customers.

10. Various types of data are provided to the customer, i.e., raw data, statistical data, delta data, or box plots (distribution) of the radiation data, as requested on the customer purchase order.

11. There are several approaches to purchasing radiation-guaranteed product. Radiation-hardened space product generally incur the highest cost due to the extra non-radiation test issues and requirements of S-Level processing.

12. Wafer and lot traceability are automatic on all RHA products.

13. Radiation data on National's logic products is guaranteed if National in South Portland, Maine, performs the radiation tests.

Certification

National operates radiation effects laboratories (REL) in South Portland, Maine; and Santa Clara, California.

South Portland, Maine

- Certified by the National Institute of Standards and Technology (NIST)
- Licensed by the Nuclear Regulatory Commission (NRC) to handle neutron-irradiated material. This capability permits testing product for both Total Dose and Neutron irradiation. National currently contracts Sandia National Labs to perform Neutron irradiation tests.
- Certified by the Defense Supply Center, Columbus, Ohio (DSCC) for Total Dose Lab Suitability. This signifies that our REL meets all government requirements to perform Total Dose testing. This certification is one of only two presently granted by DSCC.
- Lab Suitability certification denotes that testing performed at National's South Portland REL facility and the data generated are fully recognized and acceptable by all government agencies, their contractors, and subcontractors. This qualifies the South Portland REL to support JAN Class-S RHA programs for FACT product, for production radiation qualification of all of National's product lines, and for any customer-requested testing that requires Total Dose data from a DSCC-certified laboratory.
- REL research includes evaluation of National's analog, interface, logic, and memory families as well as any other products requested by customers.

Santa Clara, California

- National's Santa Clara Gammacell 220 is used for research and characterization of Total Dose effects using the current revision of MIL-STD-883 Method 1019.
- Certification and calibration of this 1.25MeV Cobalt 60 Gamma Ray machine is performed by J. L. Sheppard.
- Dose rate may be adjusted between 10 rads(Si) and 110 rads(Si).


National Semiconductor
Analog

Analog Table of Contents

National Semiconductor provides the world's most complete selection of military Analog semiconductor products — high-performance amplifiers and buffers, VIP™ op amps, CMOS rail-to-rail op amps, Low Dropout Regulators, and "multi-step" ADCs, and SIMPLE SWITCHER® series of switching regulators. Included here are all of National's Analog products that are recommended for new designs.

High-Performance Amplifiers & Buffers – Selection Guide

National's high performance amplifiers, buffers and signal-conditioning components are ideal for high-speed and high fidelity designs. Signal-conditioning products are centered around high frequency amplifiers based on current and voltage feedback technology. They include high-speed monolithic operational amplifiers, variable-gain amplifiers, unity-gain buffers, clamping amplifiers, and multiplexers.

These high-performance products meet demanding bandwidth requirements without sacrificing other performance specifications. They excel in the important areas of slew rate, settling times, and rise/fall time. At the same time, they deliver outstanding harmonic distortion, offset voltage, and input-noise specifications.

Wide Bandwidth	>1200Mhz	>800Mhz	>400Mhz	>300Mhz	>200Mhz	>100Mhz	>50Mhz
Singles	CLC449	CLC110	CLC409	CLC109	CLC401	CLC425	CLC423
		CLC111		CLC400	CLS404	CLC430	LM6121
		CLC440		CLC402	CLC405	LM6181	LM6125
				CLC410	CLC406		LM6161
				CLC411	CLC407		LM6162
				CLC420	CLC426		
					CLC501		
					CLC502		
					CLC505		
					LM7171		
Duals				CLC412	CLC428	CLC431	
						CLC432	
						LM6172	
						LM6182	
Quads			CLC115		CLC114	CLC414	
					CLC415		

High Slew Rate	>300V/µs	>400V/µs	>500V/µs	>1000V/µs	>2000V/µs	>3000V/µs
Singles	LM6161	CLC111	CLC109	CLC110	CLC401	CLC404
	LM6162		CLC405	CLC400	CLC406	CLC411
	LM6164		CLC407	CLC410	CLC409	
	LM6165		CLC425	CLC502	CLC420	
			CLC426		CLC430	
			LM6121		CLC440	
			LM6125		CLC449	
					CLC501	
					CLC505	
					LM6181	
					LM7171	
Duals			CLC428		CLC412	
					CLC431	
					CLC432	
					LM6172	
					LM6182	
Quads				CLC414	CLC415	

High-Performance Amplifiers & Buffers – Selection Guide (cont.)

Low Noise	>1nV/√Hz	>2nV/√Hz	>3nV/√Hz	>4nV/√Hz	>5nV/√Hz
Singles	CLC402	CLC400	CLC404	CLC420	CLC405
	CLC425	CLC401	CLC430	CLC446	CLC407
	CLC426	CLC406	CLC440		
		CLC409			
		CLC410			
		CLC411			
		CLC449			
		CLC501			
		CLC502			
		CLC505			
Duals		CLC412	CLC431		
		CLC428	CLC432		
Quads			CLC415	CLC414	

Low Power Quiescent	>60µW	>1mW	>10mW	>20mW	>30mW	>40mW	>50mW
Singles	LMC6061		CLC505	CLC423		CLC109	CLC406
						CLC405	CLC446
						CLC406	LM6161
						CLC407	LM6162
						CLC420	LM6164
							LM6165
Duals*	LMC6062	LMC6482					CLC412
	LMC6462	LM6142					
Quads*	LMC6064	LMC6484			CLC114		CLC415
	LMC6464	LM6144			CLC414		

* Power consumption ratings for Duals and Quads are per channel.

High-Performance Amplifiers & Buffers — Ordering Guide

Device	Leads	Description	Packages	SMD/883	JAN JM38510/ B S	QML-V MIL-S	KGD
CLC109	8	High-Speed, Low Power Buffer	B				
CLC110	8	High-Speed, Low Distortion Buffer	B, D	5962-8997501			
CLC111	8	High-Speed Buffer	B				
CLC114	14	Low Power Quad Buffer	B, D				
CLC115	14	High-Speed Quad Buffer	D				
CLC400	8	General Purpose Wideband Op Amp	B, D	5962-8997001			
CLC401	8	General Purpose High Gain Op Amp	B, D	5962-8997301			
CLC402	8	Fast 14-Bit Settling Op Amp	B, D	5962-9203301			
CLC404	8	Large-Signal Bandwidth Op Amp	D	5962-9099401			
CLC405	8	Low Power Op Amp with Disable	B				
CLC406	8	Wideband, Low Power Op Amp	B, D	5962-9200401			
CLC407	8	Programmable Gains of ±1, +2	B				
CLC409	8	Very Low Distortion Op Amp	D	5962-9203401			
CLC410	8	Wideband Op Amp with Disable	B, D	5962-9060001			
CLC411	8	High Speed Video Op Amp with Disable	B	5962-9456601			
CLC412	8	Low Crosstalk, Wideband Op Amp	B	5962-9471901			
CLC414	14	General Purpose Quad Op Amp	B, D	5962-9169301			
CLC415	14	General Purpose Quad Op Amp	B, D	5962-9305501			
CLC420	8	Very Wideband Low Power Op Amp	B, D	5962-9175801			
CLC425	8	Very Low Noise Op Amp	B	5962-9325901			
CLC426	8	Low Noise Unity-Gain Stable Op Amp	B	5962-9459701			
CLC428	8	Dual Low Noise Op Amp	B	5962-9470801			
CLC430	8	Video Op Amp	B, D	5962-9203001			
CLC431	14	Dual Video Op Amp with Disable	B	5962-9472501			
CLC432	8	Dual Video Op Amp	B	5962-9472502			
CLC440	8	Very Wideband Low Power Op Amp	B	5962-9751801			
CLC446	8	Very Wideband Low Power Amp	B	5962-9751901			
CLC449	8	Ultra Wideband Op Amp	B	5962-9752001			
CLC452	8	High-Output, Low Power Line Driver	B	5962-9752101			
CLC501	8	High Gain Op Amp with Output Clamps	B, D	5962-8997401			
CLC502	8	14-Bit Settling Op Amp with Output Clamps	B, D	5962-9174301			
CLC505	8	High-Speed Op Amp w/Programmable Supply Current	D	5962-9099301			
CLC520	14	Wideband AGC Amplifier	D	5962-9169401			
CLC522	14	Wideband Variable-Gain Amplifier	D	5962-9451701			
CLC532	14	Wide Dynamic Range 2:1 Multiplexer	B, D	5962-9203501			
CLC533	16	Wide Dynamic Range 4:1 Multiplexer	B	5962-9320301			
LM6118	8, 20	VIP Dual Op Amp	J, E	5962 -9156501		x	
LM6121	8	VIP Buffer	J, H	5962 -9081201		x	
LM6125	8, 14	VIP Buffer with Error Flag	H, J	5962 -9081501		x	
LM6161AM	8, 10, 20	VIP Op Amp (Unity Gain)	J, W, E	5962 -8962101		x	
LM6162AM	8, 10, 20	VIP Op Amp (Av >2)	J, W, E	5962 -9216501		x	

High-Performance Amplifiers & Buffers — Ordering Guide, (cont.)

Device	Leads	Description	Packages	SMD/883	JAN JM38510/ B S	QML-V MIL-S	KGD
LM6164	8, 10, 20	VIP Op Amp (Av >5)	J, W, E	5962 -8962401		x	
LM6165	8, 10, 20	VIP Op Amp (Av >25)	J, W, E	5962 -8962501		x	
LM6172AM	8, 16	VIP Voltage Feedback Op Amp	J, WG	5962-9560401		x	
LM6181AM	8	VIP Current Feedback Op Amp	J	5962 -9081802		x	
LM6182AM	14	VIP Current Feedback Dual Op Amp	J	5962 -9460301		x	
LM6142AM	8	VIP Voltage Feedback Dual Op Amp	J	5962-9550301		x	
LM6144AM	14	VIP Voltage Feedback Quad Op Amp	J	5962-9650601		x	
LM7171AM	8, 10, 10	VIP Voltage Feedback Op Amp	J, WG, W	5962-9553601		x	
LMC6462AM	8	Rail-to-Rail Micropower CMOS Dual Op Amp	J	5962-9560301		x	
LMC6464AM	14	Rail-to-Rail Micropower CMOS Quad Op Amp	J, WG	5962-9560302		x	
LMC6484AM	14	Rail-to-Rail CMOS Quad Op Amp	J, WG	5962 -9453402		x	
LMC6482AM	8	Rail-to-Rail CMOS Dual Op Amp	J	5962 -9453401		x	
LMC6061AM	8	Micropower CMOS Single Op Amp	J	5962 -9460401		x	
LMC6062AM	8	Micropower CMOS Dual Op Amp	J	5962 -9209403		x	
LMC6064AM	8	Micropower CMOS Quad Op Amp	J	5962 -9209303		x	

Package Key:

B = Ceramic DIP

D = Side-Brazed DIP

E = Ceramic LCC

H = Metal Can (TO -39, TO -5, TO -99, TO -100)

J = Ceramic DIP

W = Flatpak

WG = Ceramic SOIC

Standard Amplifiers, Buffers and Comparators — Selection Guide

To help designers turn their designs quickly and efficiently, National's industry-leading standard amplifiers, buffers, and comparators bring important design flexibility to general-purpose and analog signal conditioning applications.

Using National's comparators, designers can obtain superior performance over the the entire military temperature range – without having to resort to less optimal op amp implementations.

High Slew Rate	50V/µs
	LM118*

Low Supply Current	1.5mA	150µA
	LM124*	LF441
		LF442
		LF444

Low Vos	500µV
	LF411
	LM108*
	LM112

Low Noise	25nV/√Hz	12nV/√Hz
	LF147	LF156A
	LF411	LF157A

Low Input Bias Current	50pA	30pA	10pA
	LF411	LF155A	LF441
	LF412	LF156A	LF442
		LF157A	LF444

Dual/Quad	Dual	Quad
	LF412	LF147
	LF442	LF444
	LM158*	LM124*

High Power Bandwidth	400Khz	1.5Mhz
	LF157A	LM118

General Purpose	Industry Standard
	LM101*
	LM107*
	LM108A*
	LM139*

* Industry-standard products

Standard Amplifiers, Buffers and Comparators — Selection Guide (cont.)

DTL/TTL Fanout	1	2	5	10
	LM139*	LF111	LM111	LM106
	LM193	LM119		
		LM160		
		LM161		

Supply Voltage Range	V- = -8 V+ = 8	V- = -15 V+ = 15	± 18V or 36V DC
	LM160	LM106	LF111
			LM111
			LM139*
			LM193

Bias Current Range	25µA	15µA	0.25µA	0.15µA
	LM106	LM160	LM111	LF111
			LM139*	
			LM193	

Offset Voltage	10mV	7mV	5mV	4mV
	LF111	LM111	LM106	LM160
			LM139*	
			LM193	

Response Time	1.3µs	200ns	80ns	40ns	16ns
	LM139*	LF111	LM119	LM106	LM160
	LM193	LM111			LM161

Voltage Gain Range	3,000	40,000	200,000
	LM160	LM106	LF111
	LM161	LM119	LM111
			LM139*
			LM193

Dual/Quad	Dual	Quad
	LM119	LM139*
	LM193	

* Industry-standard products

Standard Amplifiers, Buffers, and Comparators — Ordering Guide

Device	Leads	Description	Packages	SMD/883	JAN JM38510/	B	S	QML-V MIL-S	KGD
LF111	8	Voltage Comparator	H	-MIL					
LF147	14	Wide BW Quad JFET Op Amp	J	883	11906	x	x		
LF155	8	JFET Input Op Amp	J, W, H	883	11401	x	x		
LF155A	8	JFET Input Op Amp	H	883					
LF156	8	JFET Input Op Amp	H	883	11402	x			
LF156A	8	JFET Input Op Amp	H	883					
LF157	8	JFET Input Op Amp	H	883					
LF157A	8	JFET Input Op Amp	H	883					
LF411M	8	Low Offset, Low Drift JFET Input	H	883	11904	x	x		
LF412M	8	Low Offset, Low Drift JFET Input-Dual	H, J	5962-9676001	11905	x	x		
LF441M	8	Low Power JFET Input	H	883					
LF442M	8	Low Power JFET Input-Dual	H	883					
LF444M	14	Low Power JFET Input-Quad	D	883					
LM101A	8, 10, 14	General Purpose Op Amp	J, W, H	883	10103	x	x	x	
LM106	8, 14	Voltage Comparator	H, W	8003701				x	
LM107	8, 14	General Purpose Op Amp	J, H	5962 -8958901				x	
LM108A	8, 10, 14	Precision Op Amp	J, W, H, WG	883	10104	x	x	x	x
LM110	8, 14	Voltage Follower	J, H	5962 -8760601					
LM111	8, 10, 14	Voltage Comparator	J, W, WG, H	883	10304	x	x	x	x
LM118	8, 10, 14	Fast Op Amp	J, W, WG, H	883	10107	x	x	x	
LM119	10, 14, 20	High Speed Dual Comparator	J, W, WG, E, H	883	10306	x	x	x	
LM124	14, 20	Low Power Quad Op Amp	J, W, WG, E	883	11005	x	x	x	x
LM124A	14, 20	Low Power Quad Op Amp	J, W, WG, E	883	11006	x	x	x	
LM139	14, 20	Quad Comparator	J, W, WG, E	883	11201	x	x	x	x
LM139A	14, 20	Precision Quad Comparator	J, W, WG, E	5962 -87739				x	
LM143	8	High Voltage Op Amp	H	7800303				x	
LM146	16	Quad Programmable Op Amp	J	883				x	
LM148	14	Quad 741 Op Amp	J	883	11001	x	x	x	
LM149	14	General Purpose Quad Op Amp	J	883				x	
LM158	8	Low Power Dual Op Amp	J, H	5962 -8771001				x	
LM158A	8	Low Power Dual Op Amp	J, H	5962 -8771002				x	
LM160	8, 14	High Speed Differential Comparator	J, H	8767401				x	
LM161	10, 14	High Speed Differential Comparator	J, W, H	5962 -87572				x	
LM193	8	Dual Comparator	J, H	883	11202	x	x	x	
LM193A	8	Dual Comparator	J, H	883				x	

Package Key:

D = Side -Brazed DIP

E = Ceramic LCC

G = Metal Can (TO -8)

H = Metal Can (TO -39, TO -5, TO -99, TO -100)

J = Ceramic DIP

W = Flatpak

WG = Ceramic SOIC

Linear Regulators — Selection Guide

Linear regulators have always been a mainstay of National's Linear portfolio. National maintains a large selection of products, including positive and negative voltages – all in a wide variety of voltage and current ranges.

The low power and micropower low drop out regulators support low-power applications. They require low quiescent current to extend system battery life or to limit power consumption in satellite applications. Devices such as the LP2953 also include a low-voltage error flag that can alert the system of a low voltage. It also includes an auxiliary comparator for use in fault detection. The LP2956 integrates all of these features into a dual regulator which provides a secondary output of 75mA to keep critical system components (such as RAM) powered-up even when the primary side drops out of regulation.

Positive Voltage Regulators — Selection Guide

Low Dropout Voltage	0.5V
	LM2940
	LM2941
	LP2951
	LP2953
	LP2956
	LP2960

Output Current	0.1A	0.2A	0.5A	1.0A	1.5A	3A	5A
	LP2951	LM109	LM117	LM140	LM109	LM123	LM138
	LM105	LP2953	LM117HV	LM2940	LM117	LM150	
		LP2956	LM140	LM2941	LM117HV		

Adjustable	5V…20V	1.2V…29V	1.2V…32V	1.2V…33V	1.2V…37V	1.2V…57V	4.5V…40V
	LM2941	LP2951	LM138	LM150	LM117	LM117HV	LM105
		LP2953					
		LP2956					

Fixed	5V	8V	12V	15V
	LM109	LM2940 -8.0	LM140-12	LM140-15
	LM123		LM2940-12	LM2940-15
	LM140-5.0			
	LM2940-5.0			

Negative Voltage Regulators — Selection Guide

Output Current	0.1A	1A	1.5A
	LM104	LM2990	LM120
		LM2991	LM137
			LM137HV

Fixed	-5V	-8V	-12V	-15V
	LM120-5.0	LM120 -8.0	LM120-12	LM120-15
	LM2990-5.0		LM2990-12	LM2990-15

Adjustable	-2V…-25V	-1.2V…-37V	-1.2V…-46V
	LM2991	LM137	LM137HV
		LM137A	

Linear Regulators — Ordering Guide

Device	Leads	Description	Packages	SMD/883	JAN JM38510/	JAN B	JAN S	QML-V MIL-S	KGD
Positive Voltage Regulators									
LM105	8	Adjustable Voltage Regulator	H	5962 -8958801				x	
LM109	2, 3	5V Regulator, I_O = 200mA	H, K	5962-8777401	10701	x	x	x	
LM117	2, 3	Adjustable Regulator	H, K	883	11703, 11704	x	x	x	x
LM117HV	3, 20	Adjustable Regulator, I_O = 0.5A	H, E	5962-7703402				x	
LM117HV	2	Adjustable Regulator, I_O = 1.5A	K	5962-7703402				x	
LM123	2	3A Voltage Regulator	K	883				x	
LM138	2	5A Adjustable Regulator	K	-MIL				x	
LM140-5.0	3	0.5A Fixed 5V Regulator	H	883	10702	x	x	x	
LM140-12	3	0.5A Fixed 12V Regulator	H	883	10703	x	x	x	
LM140-15	3	0.5A Fixed 15V Regulator	H	883	10704	x	x	x	
LM140-5.0	2	1.0A Fixed 5V Regulator	K	883	10706	x	x	x	
LM140-12	2	1.0A Fixed 12V Regulator	K	883	10707	x	x	x	
LM140-15	2	1.0A Fixed 15V Regulator	K	883	10708	x	x	x	
LM150	2	3A Adjustable Power Regulator	K	5962-8767501				x	
LM2940-5.0	2, 16	5V Low Dropout Regulator, I_O = 1A	K, J, WG	5962 -8958701				x	
LM2940-8.0	2, 16	8V Low Dropout Regulator, I_O = 1A	K, J, WG	5962 -9088301				x	
LM2940-12	2, 16	12V Low Dropout Regulator, I_O = 1A	K, J, WG	5962 -9088401				x	
LM2940-15	2, 16	15V low Dropout Regulator, I_O = 1A	K, J, WG	5962 -9088501				x	
LM2941	2, 16	Adjustable Low Dropout Regulator, I_O = 1A	K, J, WG	5962-9166701				x	
LP2951	8	Adjustable Micropower LDO	J, H, WG	5962 -3870501					
LP2953AM	16	Adjustable Micropower LDO I_O = 0.25A	J, WG	5962 -9233601					
LP2956AM	16	Adjustable Micropower LDO I_O = 0.25A	J	5962-9554701					
Negative Voltage Regulators									
LM120-5.0	3	Fixed 0.5A Regulator, V_{OUT} = -5V	H	883	11501	x	x	x	
LM120-8.0	3	Fixed 0.5A Regulator, V_{OUT} = -8V	H	883				x	
LM120-12	3	Fixed 0.5A Regulator, V_{OUT} = -12V	H	883	11502	x	x	x	
LM120-15	3	Fixed 0.5A Regulator, V_{OUT} = -15V	H	883	11503	x	x	x	
LM120-5.0	2	Fixed 1.0A Regulator, V_{OUT} = -5V	K	883	11505	x	x	x	
LM120-12	2	Fixed 1.0A Regulator, V_{OUT} = -12V	K	883	11506	x	x	x	
LM120-15	2	Fixed 1.0A Regulator, V_{OUT} = -15V	K	883	11507	x	x	x	
LM137	2, 3	Adjustable Regulator	H, K	5962-7703403	11803, 11804	x	x	x	x
LM137A	2, 3	Precision Adjustable Regulator	H, K	883				x	
LM137HV	2, 3	Adjustable (High Voltage) Regulator	H, K	5962-7703404				x	
LM2990-5.0	16	-5V Low Dropout Regulator, I_O = 1A	J, WG	5962-9571101				x	
LM2990-12	16	-12V Low Dropout Regulator, I_O = 1A	J, WG	5962-9571001				x	
LM2990-15	16	-15V Low Dropout Regulator, I_O = 1A	J, WG	5962-9570901				x	
LM2991	16	Adjustable Negative Regulator, I_O = 1A	J, WG	5962-9650501				x	

Package Key:

E = Ceramic LCC
H = Metal Can (TO -39, TO -5, TO -99, TO -100)
J = Ceramic DIP
K = Metal Can (TO -3)
W = Flatpak
WG = Ceramic SOIC

Switching Regulators and Motor Drivers — Selection Guide

National's selection of SIMPLE SWITCHER switching regulators offer the benefits of high efficiency, low power, and less board space. There's also design software that makes designing with the SIMPLE SWITCHER family a snap – even for those who have no previous power supply design experience.

The high frequency operation (150kHz) of the LM2595 allows the use of external passive devices that are smaller and lower-in-profile than the components required with lower-frequency switchers.

All of these devices are supported by the Switchers Made Simple® design software, which provides a complete design solution including schematics, component lists, and vendor information. Use of standard inductors or transformers available from National's passives partners precludes the need for any magnetics design.

National also offers the LMD18200 for motor driver applications. This device integrates over 30 discrete devices, saving board space and design time.

Continuous Output Current	1A	3A
	LM1575	LM1577
	LM1575HV	
	LM2595	

Output Voltage	3.3V	5V	12V	15V	Adjustable
	LM2595-3.3	LM1575-5	LM1575-12	LM1575 -15	LM1575-ADJ
		LM1575HV-5	LM1575HV-12	LM1575HV -15	LM1575HV-ADJ
		LM2595-5	LM1577-12	LM1577 -15	LM1577-ADJ
			LM2595-12		LM2595-ADJ

Maximum Input Voltage	40V	60V
	LM1575	LM1575HV
	LM1577	
	LM2595	

Functions	Step-Up	Step-Down	Flyback
	LM1577	LM1575	LM1577
		LM1575HV	
		LM2595	

Motor Driver	5.5V/3A
	LMD18200

Switching Regulators and Motor Drivers — Ordering Guide

Device	Leads	Description	Packages	SMD/883	JAN JM38510/ B	JAN S	QML-V MIL-S	KGD
LM1575-5	2, 16	SIMPLE SWITCHER Step-Down, V_{OUT} = 5V	J, K	5962 -9167201		x		
LM1575-12	2, 16	SIMPLE SWITCHER Step-Down, V_{OUT} = 12V	J, K	5962 -9167301		x		
LM1575-15	2, 16	SIMPLE SWITCHER Step-Down, V_{OUT} = 15V	J, K	5962 -9167401		x		
LM1575-ADJ	2, 16	SIMPLE SWITCHER Step-Down, Adjustable V_{OUT}	J, K	5962 -9167101		x		
LM1575-5HV	2	SIMPLE SWITCHER Step-Down, V_{OUT} = 5V	K	5962-9167202		x		
LM1575-12HV	2	SIMPLE SWITCHER Step-Down, V_{OUT} = 12V	K	5962-9167302		x		
LM1575-15HV	2	SIMPLE SWITCHER Step-Down, V_{OUT} = 15V	K	5962-9167402		x		
LM1575-ADJHV	2	SIMPLE SWITCHER Step-Down, Adjustable V_{OUT}	K	5962-9167102		x		
LM1577-12	2	SIMPLE SWITCHER Step-Up, V_{OUT} = 12V	K	5962 -9216701		x		
LM1577-15	2	SIMPLE SWITCHER Step-Up, V_{OUT} = 15V	K	5962 -9216801		x		
LM1577-ADJ	2	SIMPLE SWITCHER Step-Up, Adjustable V_{OUT}	K	5962 -9216601		x		
LM1578A	8	750mA Switching Regulator	H	5962 -8958602		x		
LM2595-3.3	16	Simple Switching Step-Down, V_{OUT} = 3.3	J, WG	5962-9687901				
LM2595-5.0	16	Simple Switching Step-Down, V_{OUT} = 5.0	J, WG	5962-9650301				
LM2595-12	16	Simple Switching Step-Down, V_{OUT} = 12	J, WG	5962-9650201				
LM2595-ADJ	16	Simple Switching Step-Down, Adjustable V_{OUT}	J, WG	5962-9650401				
LMD18200-2	24	Dual 3A, 55V H-Bridge	D	5962 -9232501				

Package Key:

D = Side -Brazed DIP

J = Ceramic DIP

H = Metal Can (TO -39, TO -5, TO -99, TO -100)

K = Metal Can (TO -3)

WG = Ceramic SOIC

Data Acquisition — Selection Guide

National's Data Acquisition portfolio consists of Analog-to-Digital converters (ADCs), Data Acquisition systems, and temperature sensors.

The LM12H458 and LM12428 are complete Data Acquisition systems on a single chip in a 44-pin package. In addition to standard Analog-to-Digital converter functions, a 12-Bit Self-Calibrating A/D, 8-Input Multiplexer, on-board reference and sample-and-hold, these National products have all of the control features necessary for independent operation, thus speeding up your DSP.

National's LM35 temperature sensor offers temperature sensing and compensation without the use of additional circuitry or look-up tables. The LM35's 10mV/˚C linear output is all you need.

Resolution	8 Bits	10 Bits	12 Bits
	ADC0851	ADC10061	ADC1241
	ADC0858	ADC10062	ADC1251
	ADC08061	ADC10064	ADC12062
			ADC12441
			ADC12451
			LM12438
			LM12H458
			CLC952

Typical Conversion Time	500ns	600ns	740ns	5.5µs	7.7µs	13.8µs	18µs
	ADC08061	ADC10061	ADC12062	LM12438	ADC1251	ADC1241	ADC0851
		ADC10062		LM12H458	ADC12451	ADC12441	ADC0858
		ADC10064					

Maximum Power Consumption	30/34mW	40mW	50mW	75mW	100mW	113mW	235mW	625mW
	LM12438	ADC1231	ADC0851	ADC12062	ADC08061	ADC1251	ADC10061	CLC952
	LM12H458	ADC12441	ADC0858			ADC12451	ADC10062	
							ADC10064	

Supply Voltage	5V	5V or ±5V
	ADC0851	ADC1241
	ADC0858	ADC1251
	ADC08061	ADC12441
	ADC10061	ADC12451
	ADC12062	CLC952
	LM12438	
	LM12H458	

Conversion Method	Successive Approximation	Multistep
	ADC0851	ADC08061
	ADC0858	ADC10061
	ADC1241	ADC10062
	ADC1251	ADC10064
	ADC12062	
	ADC12441	
	ADC12451	
	ADC12H458	
	LM12438	

Data Acquisition — Ordering Guide

Device	Leads	Description	Packages	SMD/883	JAN JM38510/ B S	QML-V MIL-S	KGD
ADC0851	16	8-Bit Analog Data Acquisition & Monitoring System	J	5962-9551301			
ADC0858	20	8-Bit Analog Data Acquisition & Monitoring System	J	5962-9551302			
ADC08061CM	20	8-Bit Multistep ADC	J	5962-9551401			
ADC10061CM	20	10-Bit Multistep ADC	J	5962-9232901			
ADC10062CM	24	10-Bit Multistep ADC with Dual Input Multiplexer	J	5962-9232902			
ADC10064CM	28	10-Bit Multistep ADC with Quad Input Multiplexer	J	5962-9232903			
ADC1241CM	28	12-Bit Plus Sign Self-Calibrating with Sample/Hold Function	J	5962 -9157801			
ADC12441CM	28	Dynamically-Tested ADC1241	J	5962 -9157802			
ADC1251CM	24	12-Bit Plus Sign Self Calibrating with Sample/Hold Function	J	5962-9157803			
ADC12451CM	24	Dynamically-Tested ADC1251	J	5962-9157804			
ADC12062M	44	12-Bit ADC with Dual Input	W	5962-9559301			
LM35	3	10mV/°C Temperature Sensor	H	TBA			
LM12438M	24	12-Bit Data Acquisition System, Serial Output	W	5962-9651101			
LM12H458M	44	12-Bit Data Acquisition System	W, WG, EL	5962 -9319502		x	

Package Key:

EL = Ceramic Quad Flatpak

H = Metal Can (TO -39, TO -5, TO -99, TO -100)

J = Ceramic DIP

W = Flatpak

WG = Ceramic SOIC

Voltage References — Selection Guide

With one of the industry's most extensive selection of voltage references, National always has the right part for your application.

Fixed Reference Voltage	1.22V	1.235V	2.5V	3.0V	3.3V	3.6V	3.9V	5V	6.9V	6.95V
	LM113	LM185-1.2	LM136 -2.5	LM103.0	LM103-3.3	LM103-3.6	LM103-3.9	LM136-5.0	LM129	LM199
			LM185 -2.5							

Adjustable Reference Voltage	1.24V…5.3V
	LM185
	LM185BY

Initial V_{OUT} Tolerance	1%	1.5%	2%	3%
	LM113-1	LM185 -2.5	LM113	LM185-2.5
	LM185	LM185B -2.5	LM185	
	LM185-1.2		LM199	
	LM136A-2.5		LM199A	
	LM136A-5.0		LM136-2.5	
			LM136-5.0	

Operating Current Range	10µA…10mA	20µA…20mA	0.4mA…10mA	0.5mA…10mA	0.5mA…20mA	0.6mA…15mA
	LM103 Series	LM185 Series	LM136 Series	LM199	LM113 Series	LM129A
						LM129B

Temperature Drift	2ppm/°C	10ppm/°C	20ppm/°C	50ppm/°C	100ppm/°C	150ppm/°C
	LM199	LM129A	LM129B	LM113	LM113	LM185-1.2
				LM185BY-1.2		LM185-2.5
				LM185BY-2.5		

Voltage References — Ordering Guide

Device	Leads	Description	Packages	SMD/883	JAN JM38510/ B S	QML-V MIL-S	KGD
LM103-3.0	2	Reference Diode, BV = 3.0V	H	7702806		x	
LM103-3.3	2	Reference Diode, BV = 3.3V	H	7702807		x	
LM103-3.6	2	Reference Diode, BV = 3.6V	H	7702808		x	
LM103-3.9	2	Reference Diode, BV = 3.9V	H	7702809		x	
LM113	2	Reference Diode with 5% Tolerance	H	5962 -8671101		x	
LM113-1	2	Reference Diode with 1% Tolerance	H	5962 -8671102		x	
LM113-2	2	Reference Diode with 2% Tolerance	H	5962 -8671103		x	
LM129A	2	Precision Reference, l0ppm/°C Drift	H	5962 -8992101		x	
LM129B	2	Precision Reference, 20ppm/°C Drift	H	5962 -8992102		x	
LM136A-2.5	3	2.5V Reference Diode, 1% V_{OUT} Tolerance	H	883		x	
LM136A-5.0	3	5V Reference Diode, 1% V_{OUT} Tolerance	H	8418002		x	
LM136-2.5	3	2.5V Reference Diode, 2% V_{OUT} Tolerance	H	883		x	
LM136-5.0	3	5V Reference Diode, 2% V_{OUT} Tolerance	H	883		x	
LM185B	3	Adjustable Micropower Voltage Reference	H	5962 -909l40l		x	
LM185BY	3	Adjustable Micropower Voltage Reference	H	883		x	
LM185BY1.2	2	1.2V Micropower Reference Diode, Low Drift	H	5962 -8759405		x	
LM185BY2.5	2	2.5V Micropower Reference Diode, Low Drift	H	5962 -8759406		x	
LM185-1.2	2	1.2V Micropower Reference Diode, Low Drift	H	5962 -8759401		x	
LM 185-2.5	2	2.5V Micropower Reference Diode, Low Drift	H	5962 -8759402		x	
LM199	3	Precision Reference, Low Tempco	H	5962 -8856102		x	
LM199A	3	Precision Reference, Ultralow Tempco	H	5962 -8856101		x	

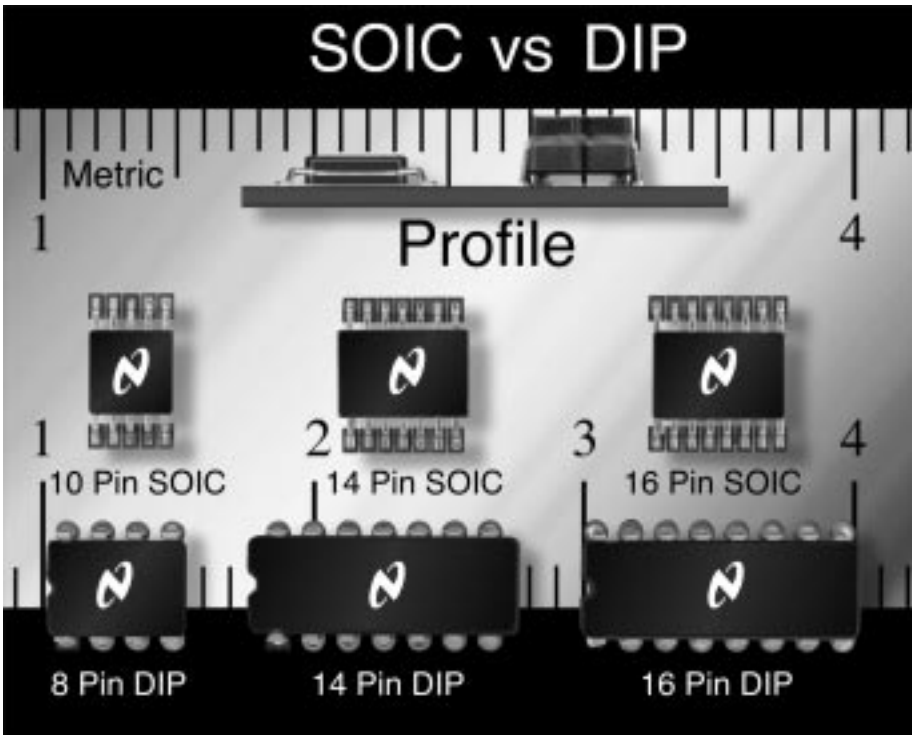
Package Key:

H = Metal Can (TO -39, TO -5, TO -99, TO -100)

Upgrades for Obsolete/Mature Analog Products

Obsolete/Mature Device	National Upgrade Device(s)	Replacement's Advantages
ADC1241CMJ/883	ADC12441CMJ/883	Dynamically tested
AH0015D-MCP	LF11201D/883	Identical switching time
CLC103AM	CLC452A8B	Only 100mA output current, but is excellent for line driving applications and requires a lower supply current.
CLC200	LM7171AMJ-QML LM7171AMWG-QML	Wider bandwidth and much lower offset voltage; monolithic
CLC205AK	CLC411A8B	Lower offset voltage and faster settling time; monolithic.
CLC206AK	CLC411A8B	Lower offset voltage and faster settling time; monolithic.
CLC207AK	LM7171AMJ-QML LM7171AMWG-QML	Low distortion characteristics and is monolithic.
CLC220	CLC446A8B	Much lower offset voltage and settles to .1% in 9ns; monolithic.
CLC221	LM7171AMJ-QML LM7171AMWG-QML	Lower distortion, wider gain bandwidth, but slower slew rate and longer settling time; monolithic.
CLC231AK	CLC111A8B	Faster slew, wider bandwidth but less output current; monolithic.
CLC232AK	LM7171AMJ-QML LM7171AMWG-QML	Monolithic, has faster slew and better 2HD/3HD performance, slightly less bandwidth
LH0002CH	LM6221H	Same pinout, better slew rate
LH0002H	LM6121H	Same pinout, better slew rate
LH0002CN	LM6221N	Different pinout, better slew rate
LH0002H-MIL	LM6121H/883	Same pinout, better slew rate
LH0002H/883	LM6121H/883	Same pinout, better slew rate

If you have board space or weight constraints, consider National's WG package option – a new QML-compliant ceramic Small Outline Integrated Circuit (SOIC) package. Because it emulates the JEDEC standard for plastic wide-body (300 mil) SOICs, the WG option has a typical footprint reduction of 37%, typical height reduction of 61%, and typical weight savings of 80% as compared with ceramic DIPs.



Upgrades for Obsolete/Mature Analog Products (cont.)

Obsolete/Mature Device	National Upgrade Device(s)	Replacement's Advantages
LH0003CH	LM6361N	Wider gain bandwidth and faster slew rate
LH0003H	LM6161J/883	Wider gain bandwidth and faster slew rate
LH0003H-MIL	LM6161J/883	Wider gain bandwidth and faster slew rate
LH0004-MIL	LM143H/883	Operates at same supply voltage
LH0004CH	LM143H	Operates at same supply voltage
LH0024H-MIL	LM6181AMJ/883	Same output current, faster slew rate and larger gain bandwidth
LH0024CH	LM6181AIN	Same output current, faster slew rate and larger gain bandwidth
LH0024H	LM6181AMJ/883	Same output current, faster slew rate and larger gain bandwidth
LH0032G-MIL	LM6181AMJ/883	Same output current, faster slew rate and larger gain bandwidth
LH0032ACG	LM6181AIN	Same output current, faster slew rate and larger gain bandwidth
LH0032CG	LM6181IN	Same output current, faster slew rate and larger gain bandwidth
LH0032G	LM6181AMJ/883	Same output current, faster slew rate and larger gain bandwidth
LH0033-MIL	CLC111A8B	Wider bandwidth; faster rise time and faster slew rate
LH0033ACG	CLC111AJE	Wider bandwidth; faster rise time and faster slew rate
LH0033CG	CLC111AJE	Wider bandwidth; faster rise time and faster slew rate
LH0033J	CLC111A8B	Wider bandwidth; faster rise time and faster slew rate
LH0033CJ	CLC111A8B	Wider bandwidth; faster rise time and faster slew rate
LH0063CK	CLC111AJP	Wider bandwidth; faster rise time; lower slew rate
LH0063K	CLC111A8B	Wider bandwidth; faster rise time; lower slew rate
LH0041CG	CLC452AJP	Lower output current but faster slew rate and larger gain bandwidth
LH0041CJ	CLC452A8B	Lower output current but faster slew rate and larger gain bandwidth
LH0041G-MIL	CLC452A8B	Lower output current but faster slew rate and larger gain bandwidth
LH0041G	CLC452A8B	Lower output current but faster slew rate and larger gain bandwidth
LH0042CH	LF412MH	Faster slew rate, lower V_{OS}, and wider gain bandwidth
LH0042H	LF412AMH	Faster slew rate, lower V_{OS}, and wider gain bandwidth
LH2111D/883	LM119J/883	Faster response time of 80ns vs. 200ns of LH2111
LH2311D	LM119J	Faster response time of 80ns vs. 200ns of LH2311
LM101A	CLC401A8B	Faster slew rate and wider bandwidth
LM102	LM6121J/883	Unity gain buffer makes an excellent voltage follower
LM107	CLC420A8B	Faster slew rate and wider bandwidth
LM110H	LM6121J/883	Unity gain buffer makes an excellent voltage follower
LM112H	LMC6061AMJ/883	LMC6061 has much lower bias and supply current
LM113	LM185	Much better TEMPCO of 50 ppm/°C vs. 100ppm/°C

Upgrades for Obsolete/Mature Analog Products (cont.)

Obsolete/Mature Device	National Upgrade Device(s)	Replacement's Advantages
LM118	CLC420A8B	Wider bandwidth and faster slew rate
LM131		See LM6165 Application tip on how to construct voltage to frequency converter using LM6165 and LM185.
LM135AH-MLS	LM135H-MLS	Direct replacement
LM146		No direct replacement, although the CLC425, CLC426, and CLC505 (singles) offer adjustable supply current options
LM148J/883	LMC6484AMJ/883	Direct replacement; has wider bandwidth
LM149J/883	CLC414A8B	Direct replacement; has better accuracy and wider bandwidth
LM709	LM108WG/883	Better precision
LM710	LM106H/883	Uses less power and has more features
LM711	LM119WG/883	80ns response time vs. 40ns of LM711
LM723	LM117	Supports higher output currents
LM725AH/883	LM6162J/883	Has lower input noise voltage; is direct replacement for LM725J
LM741	LM107J/883	Direct replacement with has less noise and better accuracy
LM747A/883	LM158AJ/883	Best direct match, lower offset current
LM748	LMC6061AMJ/883	Much lower offset voltage
LM1558J	LM6142AMJ-QML	Better gain, lower offset voltage, faster slew
LM1578H/883	LM2595J	Use LM2595 for step-down applications
LMC660AMJ/883	LMC6484AMJ/883	Direct replacement; has lower offset voltage
LMC662AMJ/883	LMC6482AMJ/883	Direct replacement; has lower offset voltage
LPC660AMJ/883	LMC6464AMJ-QML	Direct replacement; LM6464 has lower offset voltage
LPC662AMJ/883	LMC6462AMJ/883	Direct replacement; LM6462 has lower offset voltage

National Semiconductor

Customizable Solutions – ASIC

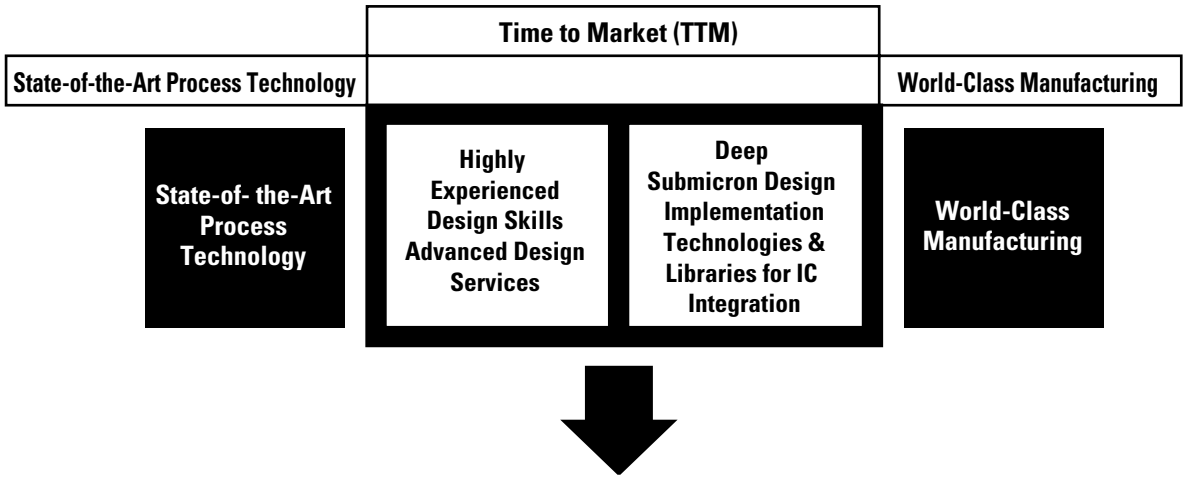
Customizable Solutions – ASIC Table of Contents

National Semiconductor offers customizable "systems-on-a-chip" solutions to all process flows and extensive packaging options. A unique competency-based alliance with Cadence Design Systems and Aspec Technology ensures complete design and manufacturing support.

Customizable "Systems-on-a-Chip" Solutions

Today's world requires that data, voice, and video information be provided fast. Processing this multimedia information requires high throughput and high bandwidth in order to deliver global and affordable solutions to military, aerospace, consumer, telecommunications, Internet appliances, industrial control solutions, and client server markets.

National Semiconductor can help with customizable "systems-on-a-chip" design solutions that support your needs for short time to market, state-of-the-art process technology, and world-class manufacturing.

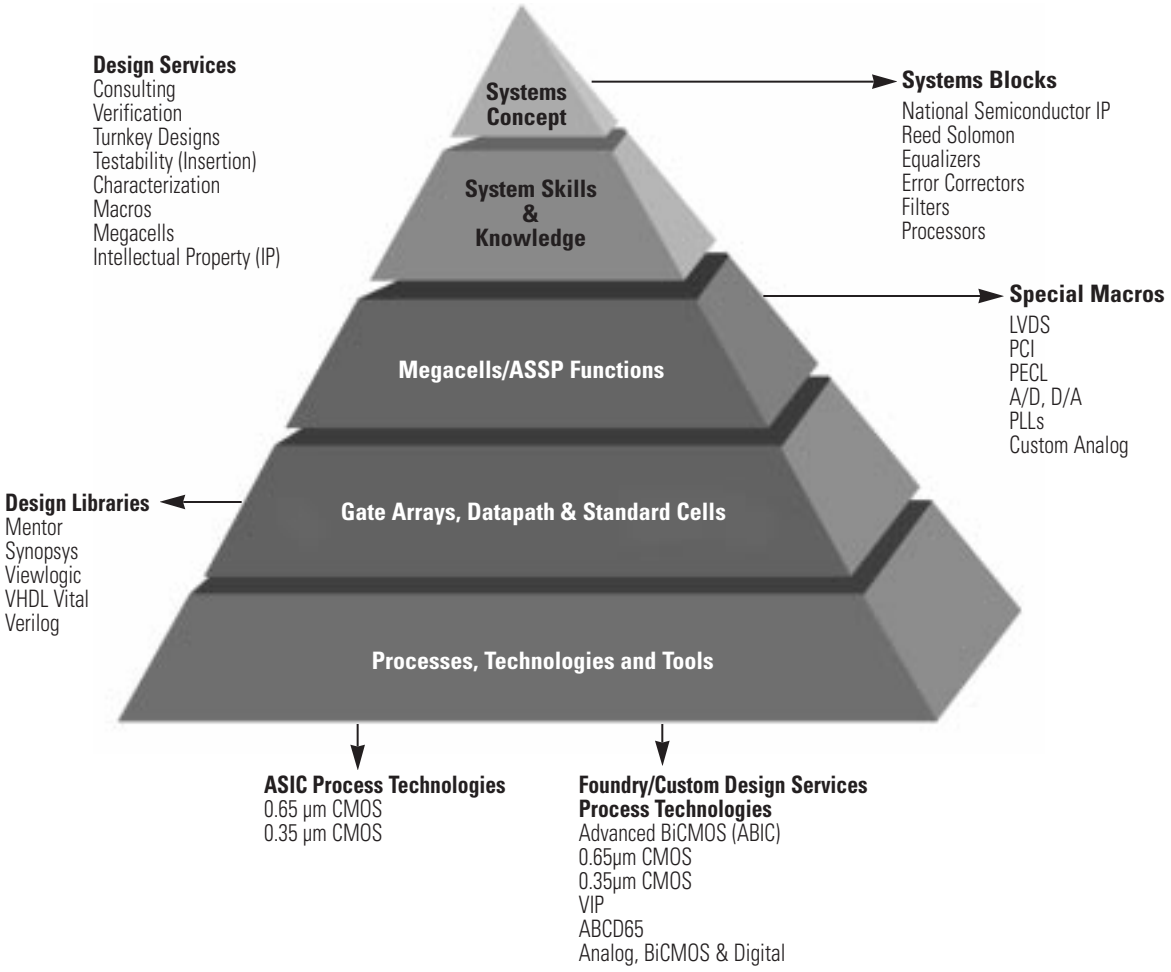


Supporting your diversity of needs, National has developed a unique competency-based alliance with Cadence Design Systems and Aspec Technology to afford you with the best resources for state-of-the-art advanced high-performance CMOS design and design services. At your discretion, functions can include anything from full custom design, to transistor-by-transistor, to complete ASIC design services. You take full control. Your GDS II database tape is backed by National's world-class manufacturing facilities.

If your deep sub-micron design requires intricate timing controls due to skews or simultaneous switching propagated across chip, engineering services are available to you. If clock tree insertion or testability is required and that's not your skill, let National help. We offer a wide range of design services to help you meet your design objectives. We can partner with you and provide services that fill the voids in your design skill portfolio.

Commercial, industrial, and military process flows are available to support your specific needs. Also available is one of the richest industry-standard packaging portfolios. This includes advanced packaging such as LTCC (Low Temperature Co-Fired Ceramic) for wireless systems design as well as high power, high pin count, ball grid array package technologies.

Top Down Design Methodology



Systems-on-a-chip requires a starting point for forward integration. At National, we are proud of our analog heritage and our leadership in mixed-signal design. The man/machine interface is real-world and that means an analog and mixed-signal capability.

Customized Support for Military/Aerospace Applications

Design Conversions for alternate sourcing (Form, Fit, Function)
Design Services
Analog/Mixed Signal and Custom Design
Design For Test (DFT)

- Scan Insertion
- JTAG IEEE 1149.1
  - ▲ TAP Controller
  - ▲ Input/Output Macros
- LSSD
- Parallel Access Testing Technique
- Compatible with National's SCAN products

Value-Added Foundry Services

- Major process technologies available
  - ▲ Advanced CMOS
  - ▲ Analog
  - ▲ Advanced BiCMOS (Ft>14GHz)
  - ▲ Bipolar

Industry-standard packaging – Where permitted meets the full MIL-PRF-38535 requirements for Qualified Manufacturing Lines (QML):

- Ceramic
- Ceramic Quad Flatpak
- Ceramic Pin Grid Arrays
- Ceramic Ball Grid Arrays
- Plastic (TQFP, PQFP, MQUAD, SBGA/BGA, PGA, MQFP)

Process flow options

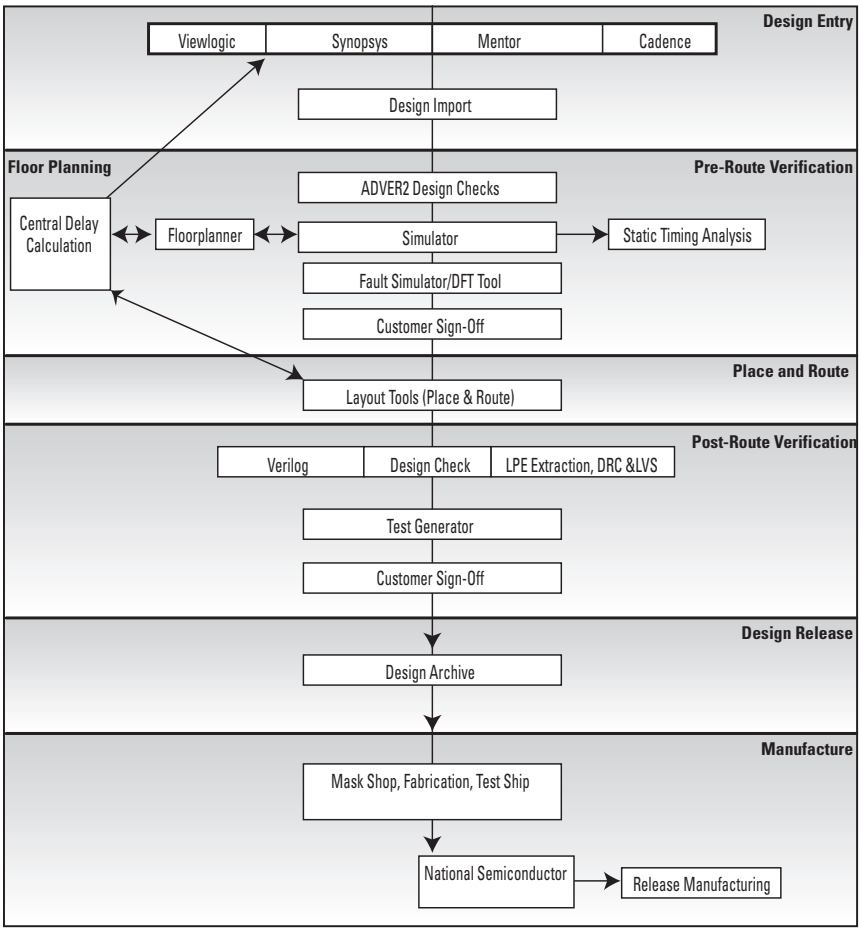
- Commercial
- Industrial
- Military

Additional manufacturing services

- Known Good Die (KGD)
- Special Testing
- Characterization

ASIC Design Methodology

- Right the first time
- Step-by-step procedure
- Retargetability



National Semiconductor's competency-based alliance with Aspec Technology provides Design Implementation Technology (DIT) that is tuned for the rigors of deep submicron design. Additionally there are the benefits of retargetability and portability which minimize the effects of process obsolescence.

National's Design Methodology supports the tools used by our customers. Not being bound by proprietary tools, we provide front-end design kits that support our customer's tool suite. This includes symbols and simulation models as well as synthesis and HDL Libraries that include Verilog and VHDL for both National's standard cell and gate array high density libraries. Additionally, National provides libraries for design-for-test tools as well as floorplanners – critical when high speed deep submicron designs require minimum timing skews.

ADVER™ (ASPEC Design Verifier) software is the primary communication link between the customer and National. Calculating the necessary pre- and post-layout delays from National's performance database, timing values are used for back annotation into design simulations. Simulations take into account interconnect, worst-case temperature, voltage, and process. This ensures first-time working silicon. This software's timing accuracy is portable across workstation platforms and simulators, making any simulator a "golden" simulator.

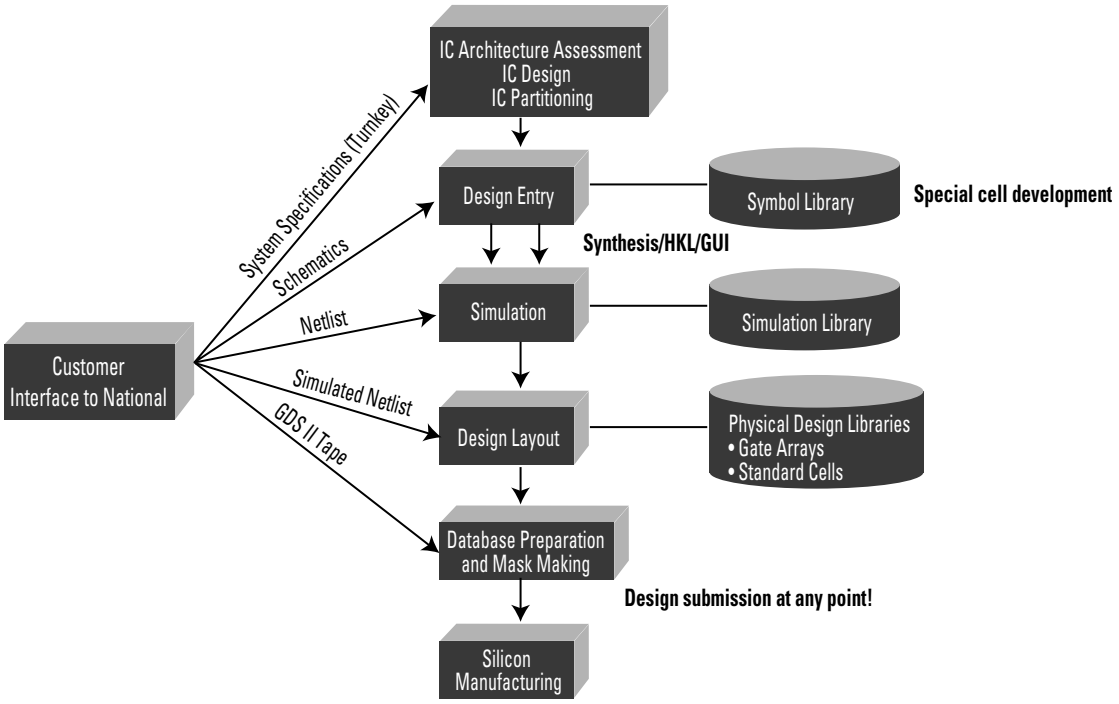
Design Kits

The table on the right is a sample of the design kits available from National Semiconductor for both our 0.65µm and 0.35µm CMOS Libraries. Contact our Sales Representative about your design flow, if your requirements are not listed.

Development Tool	Vendor Supported
Behavioral	VHDL Vital (Model Tech, Mentor, etc.)
	Synopsys Vss
	Verilog
Synthesis	Synopsys
Floor Planning	Cadence HLD
Symbol, Logic, Timing	Cadence
	Viewlogic
	Mentor
Delay Calculation	ADVER
Static Timing Analysis	Synopsys
	Motive
	Pearl
Place and Route	Cadence Cell3
	• Libraries developed by Aspec Technology

Design Services

National can accept your design anywhere in the design flow.



National Semiconductor

- Leader in Military and Aerospace semiconductors
- State-of-the-art process technology provider
- World-class manufacturer
- Fully compliant Quality and Reliability Programs

Cadence Design Systems

- EDA leader
- Full suite of design services
- Multiple design centers

Aspec Technology

- Leader in Design Implementation Technology (DIT)
- Technology library leader
- High density ASIC architecture for Gate Array standard cells

National Semiconductor's alliance with Cadence Design Systems provides the ultimate in design resources. Cadence supports the design aspect from its design factory headquartered in San Diego, California.

National has a long history of providing military customers with state-of-the-art technology and manufacturing. This is now coupled with Cadence's vast knowledge and skills in EDA and world-wide network for design services. These capabilities further combine with National's Intellectual Property (IP) to provide our customers with the broadest, most advanced design capability dedicated to the military and aerospace communities.

Services include:

- Turnkey designs
- Characterization
- Design for Test (DFT)
- Custom design (Analog & Mixed Signal)
- Macro/Megacell development
- Reliability analysis
- Debug and Failure Analysis

ASIC Product Families

SCX065 Gate Array Family Features

- Compatible libraries
- Over 700,000 raw gates
- Over 2,400 I/O buffer combinations
- Special I/O available: GTL, PECL, SCSI, PCI
- 5.0V, 3.3V, and mixed 5V/3.3V or lower voltages
- Supports the major third party tools and vendors
- ADVER™ Central Delay Calculator/Design Verifier
- Design for Testability (DFT)
  - JTAG Boundary Scan (IEEE1149.1)
- Megacell functions
  - TMS320C50,80C51, Analog, etc.

Preliminary SCL035 Standard Cell Family Features

- Compatible libraries
- Over 1.5 million gates
- Over 2,400 I/O buffer combinations
- Special I/O available: GTL, PECL, SCSI, PCI
- 5.0V, 3.3V, and mixed 5V/3.3V or lower voltages
- Supports the major third party tools and vendors
- ADVER Central Delay Calculator/Design Verifier
- Design for Testability (DFT)
  - JTAG Boundary Scan (IEEE1149.1)
- Megacell functions
  - TMS320C50,80C51, Analog, etc.

Gate Array Masterslice Listing

Device	Array Name	Total Gates DLM	Useable Gates TLM	Useable Gates	Max I/O Pads
1	MG6B	6,439	2,898	4,636	48
2	MG6C	11,781	5,301	8,482	64
3	MG6E	18,960	8,532	13,651	80
4	MG6F	25,482	11,212	17,939	92
5	MG6G	30,098	13,243	21,189	100
6	MG6H	41,064	17,658	28,252	116
7	MG6J	50,435	21,687	34,699	128
8	MG6K	64,380	27,683	44,293	144
9	MG6L	79,860	33,541	53,666	160
10	MG6M	97,188	38,875	62,200	176
11	MG6N	115,434	45,019	72,031	192
12	MG6P	136,095	51,716	82,746	208
13	MG6R	170,387	63,043	100,869	232
14	MG6S	220,844	79,504	127,206	264
15	MG6T	278,740	97,559	156,094	296
16	MG6U	343,368	116,745	186,792	328
17	MG6W	433,152	142,940	228,704	368
18	MG6X	533,352	170,673	273,076	408

Packaging

Sampling of Available Packaging

Package Type	Lead Count
Ceramic DIP	24, 28, 40, 48
Ceramic Quad Flatpaks	44, 68, 84, 128, 132, 144, 152, 172, 196, 256
Ceramic Pin Grid Arrays	68, 84, 124, 144, 155, 180, 224
Ceramic Ball Grid Arrays	Consult National CBU; industry-standard pin counts available
Plastic – TQFP, PQFP, MQUAD, SBGA/BGA, PGA, MQFP	Consult National CBU; industry-standard pin counts available

National Semiconductor

Interface

Interface Table of Contents

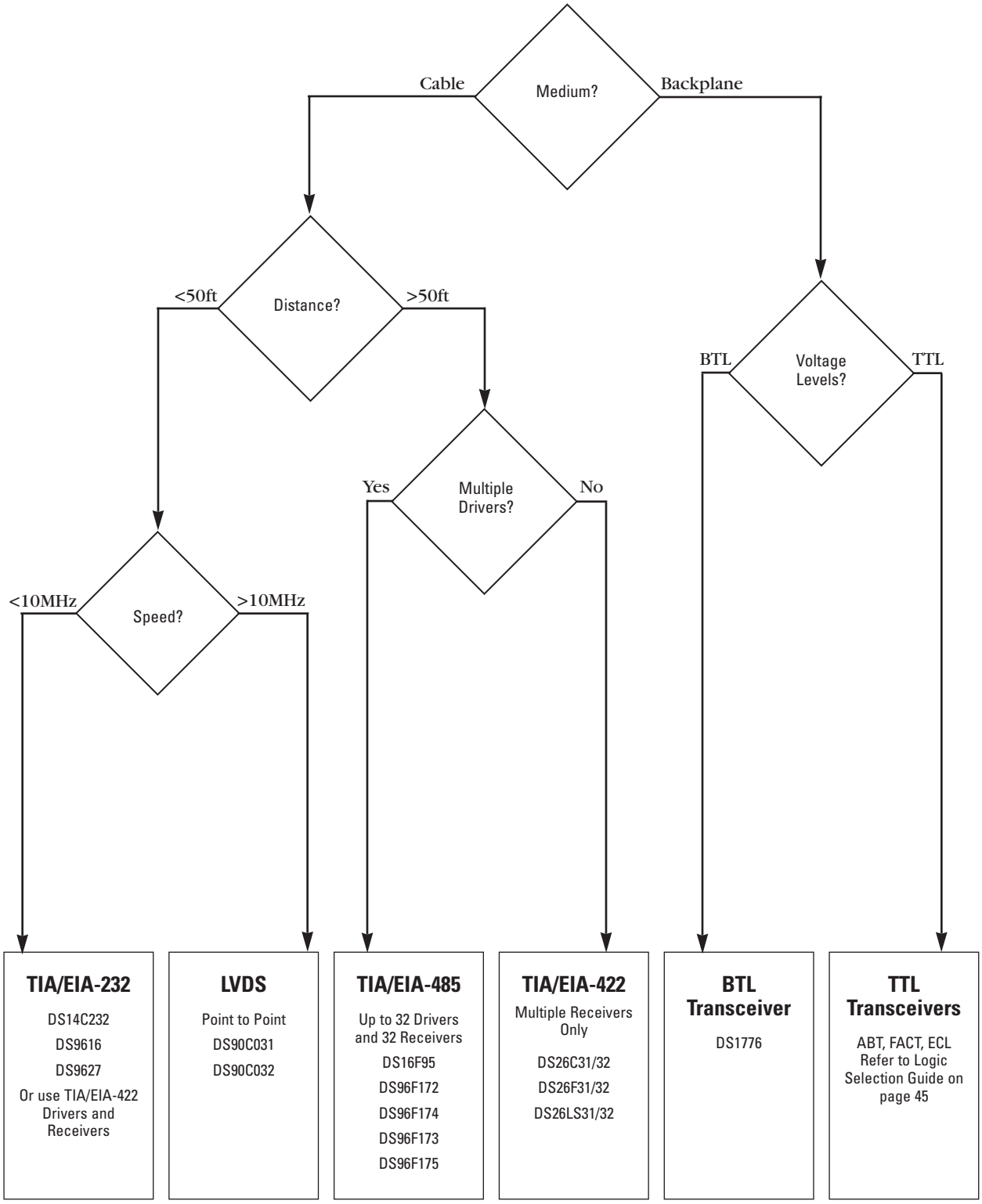
National Semiconductor offers a wide variety of data transmission products.

For single-ended line, differential line, and backplane applications, National offers a broad line of drivers, receivers, and transceivers.

TIA/EIA-232 devices are designed for 10kbps single-ended data transmission over distances up to 50 feet. TIA/EIA-422 drivers can transmit data differentially up to 10 receivers at rates as high as 10Mbps. TIA/EIA-485 products provide true multipoint communications with up to 32 drivers and 32 receivers connected to a single bus.

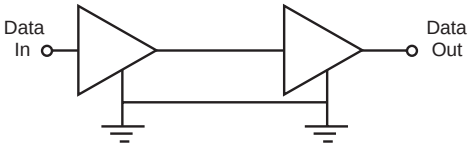
National's new LVDS Quad Line Driver and Receiver offer new alternatives for low-noise applications that demand high speed and low power consumption. These devices support data rates in excess of 155.5Mbps (77MHz) using Low Voltage Differential Signaling (LVDS) technology. Compatible with IEEE 1596.3 SCI LVDS, they provide a standard pin-compatible upgrade from the DS26LS31/32, DS26F31/32, and DS26C31/32 line drivers and receivers.

Interface Selection Tree



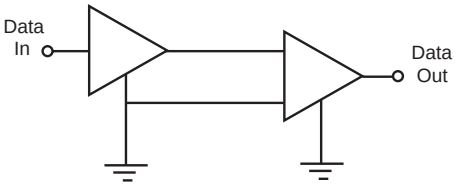
TIA/EIA Specifications

TIA/EIA-232-E Application



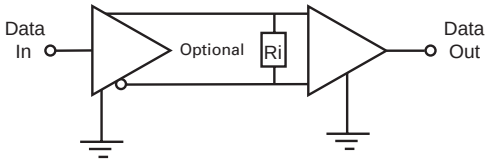
TIA-EIA-232-E was developed for Single-ended Transmission at relatively slow data rates (20kb/s) over short distances (typically up to 50ft).

TIA/EIA-423-A Application



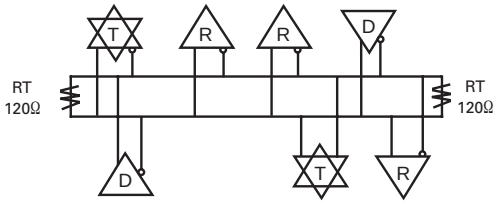
TIA/EIA-423-A extends the data rate of TIA/EIA-232 to 100kb/s (up to 30ft) and the maximum distance to 4000ft (up to 1kb/s). TIA/EIA also requires high impedance driver outputs with power off to not load the transmission line.

TIA/EIA-422-A Application



TIA/EIA-422-A is a differential data transmission standard that allows data rates up to 10Mbps (up to 40ft) and line lengths up to 4000ft (up to 100Kbps).

TIA/EIA-485 Application



TIA/EIA-485-A meets all the requirements of TIA/EIA-422 and allows up to 32 drivers and 32 receivers to be connected to a single bus to form a true multipoint bus. TIA/EIA-485 also features an extended common-mode range (-7v to +12v) for both drivers and receivers in TRI-STATE and with power off, and drivers can withstand contention and bus faults.

Specification	TIA/EIA-232	TIA/EIA-423	TIA/EIA-422	TIA/EIA-485
Mode of Operation	Single-ended	Single-ended	Differential	Differential
Number of Drivers and Receivers allowed on one line	1 Dr, 1 Rr	1 Dr, 10 Rr	1 Dr, 10 Rr	32 Dr, 32 Rr
Maximum Cable Length	~ 50 feet	4000 feet	4000 feet	4000 feet
Maximum Data Rate	20 kb/s	100 kb/s	10 Mb/s	10 Mb/s
Driver Output Maximum Voltage	+/- 25 V	+/- 6 V	- 0.25 to +6 V	-7 to +12V
Driver Output Signal Level (Loaded)	+/- 5 V to +/-15 V	+/- 3.6 V	+/- 2 V	+/- 1.5 V
(Unloaded)	+/- 25V	+/- 6V	+/- 6 V	+/- 6 V
Driver Load Impedance	3 to 7 KΩ	>/= 450 Ω	100 Ω	54 Ω
Maximum Driver Output Current (Power On)	N/A	N/A	N/A	+/- 100 µA
(High Impedance State) (Power Off)	+/-6.6 mA (+/- 2V)	+/- 100 µA	+/- 100µA	+/- 100 µA
Slew Rate	30V/µs max	Controls Provided	N/A	N/A
Receiver Input Voltage Range	+/- 15 V	+/- 12 V	-10 to +10V	-7 to +12 V
Receiver Input Sensitivity	+/- 3 V	+/- 200 mV	+/- 200 mV	+/- 200 mV
Receiver Input Resistance	3 to 7 K Ω	4 K Ω min	4 K Ω min	~ >/= 12 K Ω min

See TIA/EIA Standards for exact conditions and limits.

Transmission Line Drivers, Receivers & Transceivers Ordering Guide

Device	Leads	Description	Packages	SMD/883	JAN* JM38510/ B S RH	QML-V MIL-S	KGD
LVDS Products							
DS90C031	20	Quad LVDS Line Driver	LCC	5962-9683301			
DS90C932	20	Quad LVDS Line Receiver	LCC	5962-9683401			
TIA/EIA-232 Products							
DS14C232	16	Dual Line Driver & Receiver	CDIP, LCC	883			
DS9616	14	Triple Line Driver	CDIP, LCC	883			
DS9627	16	Dual Line Receiver	CDIP, LCC	5962-8978701			
TIA/EIA-422/423 Products							
DS1691A	16	Single Line Driver	CDIP	883			
DS26C31M	16	Quad Line Driver	CDIP, F/P, LCC	5962-9163901		x	x
DS26C32AM	16	Quad Line Receiver	CDIP, F/P, LCC	5962-9164001		x	x
DS26F31M	16	Quad Line Driver	CDIP, F/P, LCC	5962-7802302		x	x
DS26F32M	16	Quad Line Receiver	CDIP, F/P, LCC	5962-7802005		x	x
DS26LS31M	16	Quad Line Driver	CDIP, F/P, LCC	5962-7802301		QML-V	
DS26LS32M	16	Quad Line Receiver	CDIP, F/P, LCC	5962-7802006		x	
DS26LS33M	16	Quad Line Receiver	CDIP, F/P, LCC	883		x	
DS78C20	14	Dual Line Receiver	CDIP	883			
DS78C120	16	Dual Line Receiver	CDIP, F/P	883		x	
DS78LS120	16	Dual Line Receiver	CDIP, F/P	883		x	
DS9636AM	8	Dual Line Driver	CDIP	5962-8752301			
DS9637AM	8	Dual Line Receiver	CDIP	5962-8752401			
DS9638M	8	Dual Line Driver	CDIP	5962-8754601		x	
TIA/EIA-485 Products							
DS16F95	8	High-Speed Single Transceiver	CDIP, F/P, LCC	5962-8961501		x	x
DS96F172M	16	Quad Line Driver	CDIP, F/P, LCC	5962-9076501			
DS96F173M	16	Quad Line Receiver	CDIP, F/P, LCC	5962-9076602			
DS96F174M	16	Quad Line Driver	CDIP, F/P, LCC	5962-9076502		x	
DS96F175M	16	Quad Line Receiver	CDIP, F/P, LCC	5962-9076601		x	
General Purpose Products							
DS1603	14	Dual TRI-STATE® Line Receiver	CDIP	883			
DS55113	16	Dual Differential TRI-STATE Line Driver	CDIP	883			
DS55115	16	Dual Differential Line Receiver	CDIP, F/P		10404 x		
DS55122	16	Triple Line Receiver	CDIP	883			
DS7820	14	Dual Line Receiver	CDIP, F/P	883		x	
DS7820A	14	Dual Line Receiver	CDIP, F/P	883		x	
DS7830	16	Dual Differential Line Driver	CDIP, F/P	883		x	
DS7831	16	Dual Differential TRI-STATE Line Driver	CDIP, F/P	8004101			
DS7832	16	Dual Differential TRI-STATE Line Driver	CDIP, F/P	8004102			

* Where the JAN part number is the same as the SMD part number, this device is available under the One Part-One Part Number DESC drawing system.

Transmission Line Drivers, Receivers & Transceivers Ordering Guide (cont.)

Device	Leads	Description	Packages	SMD/883	JAN* JM38510/ B S RH	MIL-S KGD
General Purpose Products (cont.)						
DS7833	16	Quad TRI-STATE Transceiver	CDIP, F/P	883		
DS7837	16	Quad Unified Bus Receiver	CDIP, F/P	883		
DS9615M	16	Dual Differential Line Receiver	CDIP, F/P, LCC	883		x
DS9622M	16	Triple Line Receiver	CDIP, F/P, LCC	883		
MM78C29	14	Quad Single-Ended Line Driver	CDIP, F/P	883		
MM78C30	14	Dual Differential Line Driver	CDIP	883		
Advanced Bus Order Guide						
DS1776	28	Octal PI Bus Transceiver	LCC	5962-9231701		
Memory Support Order Guide						
DS0026	8	5MHz 2-Phase MOS Clock Driver	CDIP, MCAN	7800802		x
Peripheral/Power Drivers Order Guide						
DP7311	20	Octal Latched Peripheral Driver	CDIP	883		
DS1631	8	CMOS Dual Peripheral Driver	CDIP, MCAN	883		
DS1632	8	CMOS Dual Peripheral Driver	CDIP, MCAN	883		
DS1634	8	CMOS Dual Peripheral Driver	CDIP, MCAN	883		

* Where the JAN part number is the same as the SMD part number, this device is available under the One Part-One Part Number DESC drawing system.

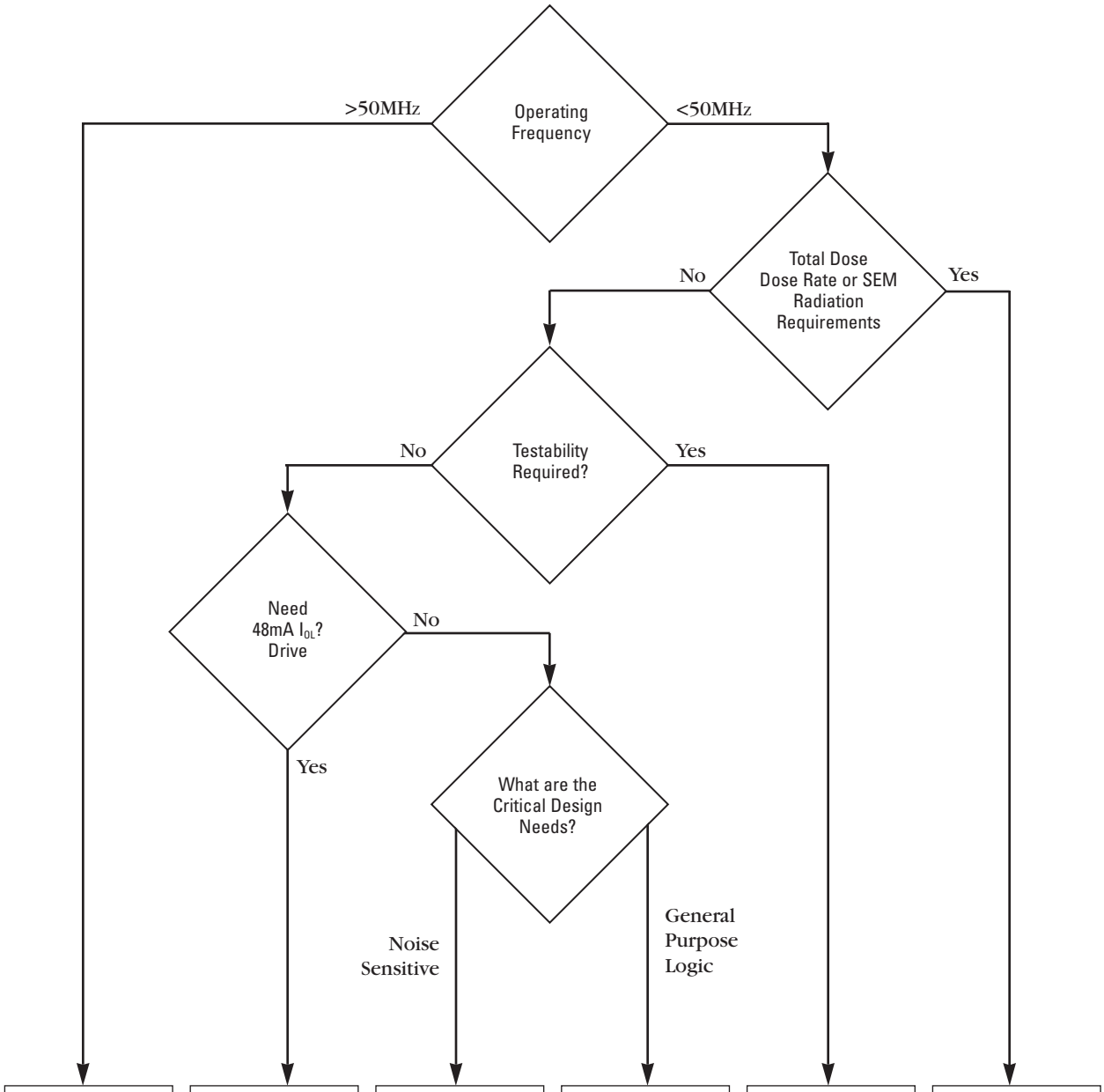
National Semiconductor

Logic

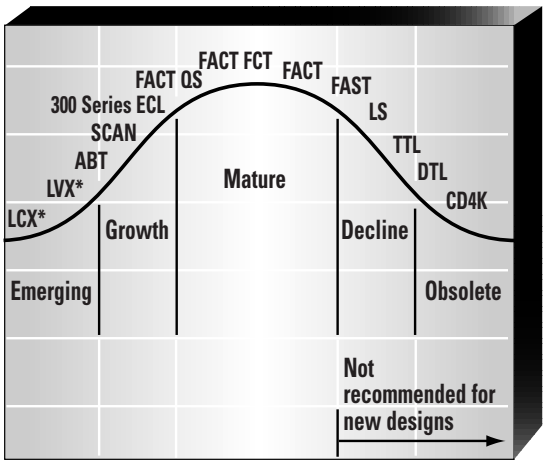
Logic Table of Contents

National Semiconductor provides the world's most complete selection of military Logic products — high-performance BiCMOS, CMOS, and bipolar functions as well as System & Board Test (IEEE 1149.1) products. Each family uniquely combines certain process and design techniques to address their evolving roles in system design. Included here are all of National's Logic products that are recommended for new designs.

Logic Product Selection Guide

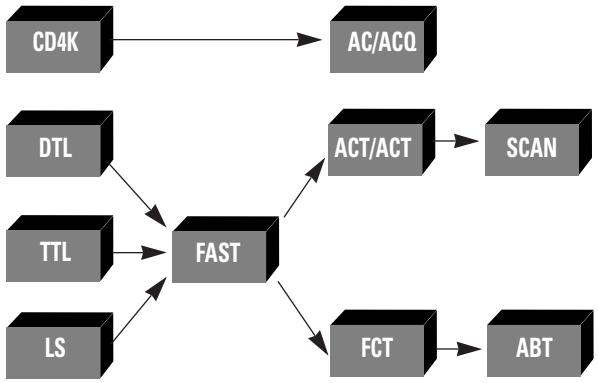


Product Life Cycle



*In Development

Product Upgrade Path



Logic Selector Guide

	Specified Power Supply (1)	Compatibility Input (2)	Compatibility Output (3)	Input Current (4)	Drive (5)	Supply Current (4)	Speed (4)	Noise (6)	
	V_{CC} ±10%	V_{IL}/V_{IH}	V_{OL}/V_{OH}	I_{IL}/I_{IH}	I_{OL}/I_{OH}	I_{CC}	T_{PD}	V_{OLP}	V_{OLV}
BiCMOS									
ABT	5V	TTL	TTL	-2µA/2µA	48/-24	30mA	5.3ns	0.8V	-1.3V
CMOS									
FACT AC	3.3V/5V	CMOS	TTL, CMOS	-1µA/1µA	24/-24	160µA	9.5ns		
FACT QS ACQ	3.3V/5V	CMOS	TTL, CMOS	-1µA/1µA	24/-24	160µA	9.0ns	1.5V	-1.2V
FACT ACT	5V	TTL, CMOS	TTL, CMOS	-1µA/1µA	14/-24	160µA	10.0ns		
FACT QS ACTQ	5V	TTL, CMOS	TTL, CMOS	-1µA/1µA	24/-24	160µA	9.0ns	1.5V	-1.2V
FACT FCT	5V	TTL, CMOS	TTL, CMOS	-5µA/5µA	48/-12	1.5mA	7.5ns		
SCAN	5V	TTL, CMOS	TTL, CMOS	-1µA/1µA	48/-24	168µA	10.5ns	0.8V	-0.8V
Bipolar									
FAST	5V	TTL	TTL	-16µA/20µA	48/-12	90mA	7.0ns		
LS	5V	TTL	TTL	-200µA/20µA	12/-12	46mA	18.0ns		
ECL									
300 Series	-5.7V to -4.2V	ECL	ECL	0.5µA/340µA	50Ω to -2V	-150mA	2.70ns	n/a	n/a

Above parameters are based on specifications for:

BiCMOS, CMOS, Bipolar = '244 device

ECL = '352 device

SCAN = '18541 device

(1) Except for ECL

(2) Input levels recognized by the device

(3) Input levels the device is capable of driving

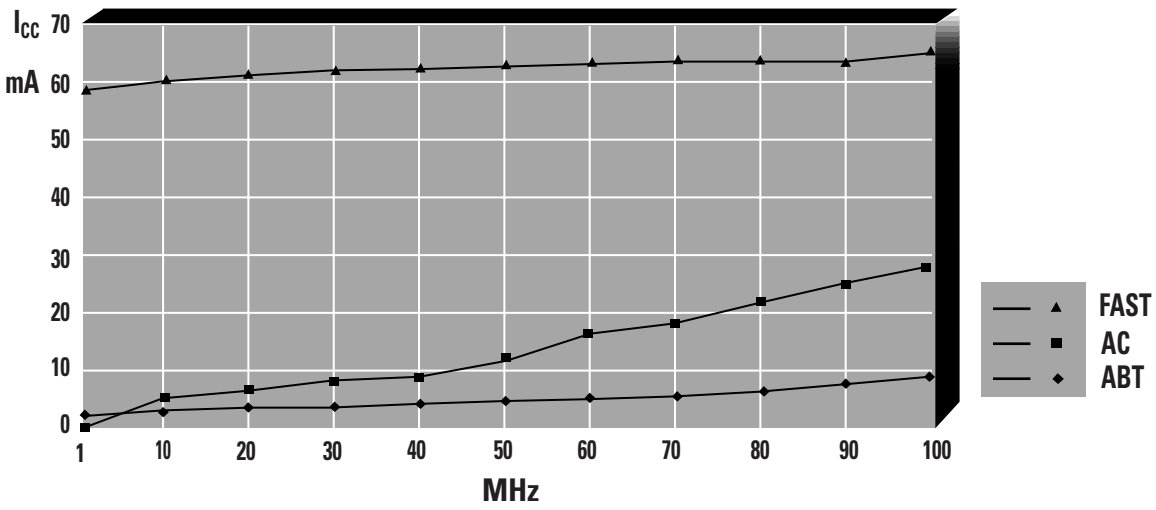
(4) Maximum specification at maximum specified V_{CC}

(5) At maximum specified V_{CC}, -55°C to +125°C

(6) +25°C

n/a Not applicable

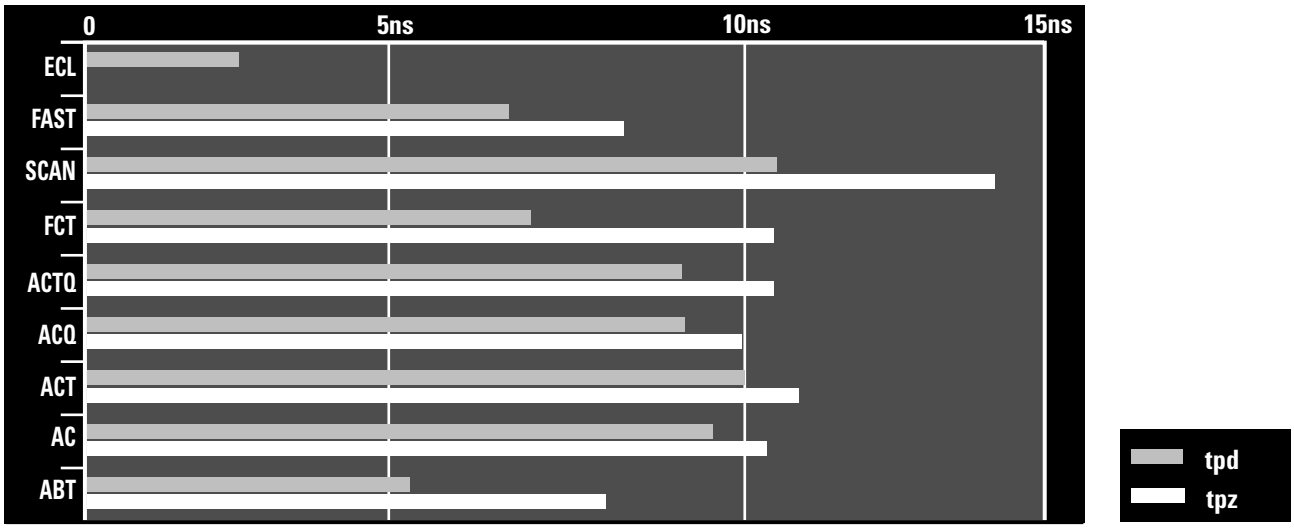
Dynamic Power



	1MHz	10MHz	50MHz	80MHz	100MHz
BiCMOS					
ABT	1.45	2.00	4.47	6.44	7.85
CMOS					
AC	0.24	2.4	12.22	21.61	26.78
ACQ	0.45	4.5	15.46	17.82	19.94
ACT	0.26	2.56	13.45	22.05	27.6
ACTQ	0.44	4.43	13.7	14.76	15.86
FCT	0.39	3.88	14.66	17.39	20.33
SCAN	0.81	2.51	9.8	15.06	18.13
Bipolar					
FAST	59.48	60.07	62.59	64.86	66.27
LS	30.32	34.55	F/F	F/F	F/F
ECL					
300 Series	216.8	216.8	216.8	216.8	216.8

F/F = Functional Failure (device fails >45MHz) Single output switch, +25°C, V_{IH} = 5.5V, V_{CC} = 5.5V – except for ECL, V_{EE} = -5.5V

Propagation Delay



Datasheet maximum specification -55°C to +125°C

ABT Logic

Advanced BiCMOS technology offers the dynamic power savings of CMOS with the speed and drive of TTL. Propagation delays as low as 4.8ns support increased up-time in critical systems. Guaranteed high impedance through the power-up/power-down cycle coupled with a staggered pin connector eliminates bus disruption during live board insertion. Faster disable than enable times help avoid bus contention. Extended National ABT specifications provide real-world information. By lowering the margin of error, systems can be pushed to even higher performance levels.

Device	Leads	Description	Package	SMD	QML-V	KGD
ABT Ordering Guide						
54ABT240	20	Inverting Octal Buffer/Line Driver	J, W, E	5962-9318801†		
54ABT241	20	Octal Buffer/Line Driver	J, W, E	5962-9322701†		
54ABT244	20	Octal Buffer/Line Driver	J, W, E	5962-9214701†	QML-V	x
54ABT245	20	Octal Transceiver	J, W, E	5962-9214801†		x
54ABT273	20	Octal D Flip-Flop	J, W, E	5962-9321701†		
54ABT373	20	Octal D Latch with TRI-STATE	J, W, E	5962-9321801†		
54ABT374	20	Octal D Flip-Flop with TRI-STATE	J, W, E	5962-9314901†		
54ABT377	20	Octal D Flip-Flop with Clock Enable	J, W, E	5962-9314801†		
54ABT541	20	Octal Buffer/Line Driver w/Broadside Pinout	J, W, E	5962-9471801†		
54ABT543	24	Octal Transceiver/Latch	J, W, E	5962-9231401†		
54ABT573	20	Octal D Latch with Broadside Pinout	J, W, E	5962-9321901†		
54ABT574	20	Octal D Flip-Flop with Broadside Pinout	J, W, E	5962-9322001†		
54ABT646	24	Octal Register/Transceiver	J, W, E	5962-9457701†		
54ABT652	24	Octal Transceiver/Register	J, W, E	5962-9324201†		
54ABT899	28	9-Bit Bidirectional Transceiver Generator/Checker	J, W, E	5962-96871•		
54ABT2244	20	Octal Buffer with 25 Ohm Series Resistor	W	Pending		
54ABT16244	48	16-Bit Buffer/Line Driver	W	5962-9317402†		
54ABT16245	48	16-Bit Register/Transceiver	W	5962-9317502†		
54ABT16373	48	16-Bit Octal D Latch	W	5962-9320001†		
54ABT16374	48	16-Bit Flip-Flop with TRI-STATE	W	5962-93201•		
54ABT16500	56	18-Bit Universal Transceiver	W	5962-9687001†		
54ABT16646	56	18-Bit Universal Transceiver	W	5962-9450202		

• Pending

† Qualified under QML as SMD

* Where the JAN part number is the same as the SMD part number, this device is available under the One Part-One Part Number DESC drawing system.

** RHA = 100 krad qualification. Contact us for radiation tolerance of non-qualified parts.

Package Key:

J = CDIP

W = Ceramic Flatpak

E = Ceramic LCC

FACT™ Logic

National's general purpose, broad portfolio, Advanced CMOS family offers superior line driving characteristics, excellent ESD tolerance, high radiation resistance, 5.0 and 3.3 volt operation, and latchup immunity. FACT products feature wide fanout capability and an extended power supply range that is guaranteed at 2V - 6V V_{DD}. Typical power consumption is 0.1mW per gate. Propagation delays are less than 5ns at 50pF load.

FACT logic is available in AC (CMOS inputs & outputs) and ACT (TTL inputs/CMOS outputs) versions. Many FACT products offer RHA (Radiation Hardness Assurance) guarantees to the 100 krad level.

Device	Leads	Description	Package	SMD/883	JAN* JM38510/	B	S	RHA**	QML-V MIL-S	KGD
FACT AC Ordering Guide										
54AC00	14	Quad 2-Input NAND Gate	D, F, L	5962-8754901	75001	x	x	x		
54AC02	14	Quad 2-Input NOR Gate	D, F, L	5962-8761201	75101	x	x	x		
54AC04	14	Hex Inverter	D, F, L	5962-8760901	75701	x	x	x		x
54AC05	14	Hex Inverter with Open Drain	D, F, L	5962-9059001	90590	x	x			x
54AC08	14	Quad 2-Input AND Gate	D, F, L	5962-8761501	75203	x	x	x		
54AC10	14	Triple 3-Input NAND Gate	D, F, L	5962-8761001	75002	x	x	x		
54AC11	14	Triple 3-Input AND Gate	D, F, L	5962-8761101	75204	x	x	x		
54AC14	14	Hex Inverter with Schmitt Trigger	D, F, L	5962-8762401	75702	x	x	x		x
54AC20	14	Dual 4-Input NAND Gate	D, F, L	5962-8761301	75003	x	x	x		
54AC32	14	Quad 2-Input OR Gate	D, F, L	5962-8761401	75201	x	x	x		x
54AC74	14	Dual D Flip-Flop	D, F, L	5962-8852001	75302	x	x	x		
54AC86	14	Quad 2-Input Exclusive OR Gate	D, F, L	5962-8955001	75202	x	x	x		
54AC109	16	Dual JK Flip-Flop	D, F, L	5962-8955101	75304	x	x	x		
54AC125	14	Quad TRI-STATE Buffer	D, F, L	883	93253	x	x	x		
54AC138	16	1-of-8 Decoder/Demultiplexer	D, F, L	5962-8762201	75802	x	x	x		x
54AC139	16	Dual 1-of-4 Decoder/Demultiplexer	D, F, L	5962-8762301	75803	x	x	x		x
54AC151	16	8-Input Multiplexer	D, F, L	5962-8769101	76201	x	x			
54AC153	16	Dual 4-Input Multiplexer	D, F, L	5962-8762501	76202	x	x	Pending		x
54AC157	16	Quad 2-Input Multiplexer	D, F, L	5962-8953901	76203	x	x	Pending		x
54AC158	16	Quad 2-Input Multiplexer	D, F, L	5962-8972901					x	
54AC161	16	4-Bit Binary Counter Async Reset	D, F, L	5962-8956101	76302	x	x	x		
54AC163	16	4-Bit Binary Counter Sync Reset	D, F, L	5962-8958201	76304	x	x			
54AC169	16	4-Bit Binary Up/Down Counter	D, F, L	5962-9160301				Pending	x	
54AC174	16	Hex D Flip-Flop w/Master Reset	D, F, L	5962-8762601	75307	x	x	x		
54AC175	16	Quad D Flip-Flop	D, F, L	5962-8955201				Pending	x	
54AC191	16	4-Bit Binary Up/Down Counter	D, F, L	5962-8974901	76305	x	x	x		
54AC240	20	Inverting Octal Buffer/Line Driver	D, F, L	5962-8755001	75703	x	x	x		x
54AC241	20	Octal Buffer/Line Driver	D, F, L	5962-8755101	75704	x	x	x		x
54AC244	20	Octal Buffer/Line Driver	D, F, L	5962-8755201	75705	x	x	x		x
54AC245	20	Octal Transceiver	D, F, L	5962-8775801	75503	x	x	x		x
54AC251	16	8-Input Multiplexer with TRI-STATE	D, F, L	5962-8769201					x	
54AC253	16	Dual 4-Input Multiplexer	D, F, L	5962-8769301					x	
54AC257	16	Quad 2-Input Multiplexer	D, F, L	5962-8870301	76207	x	x			x
54AC258	16	Quad 2-Input Inverting Multiplexer	D, F, L	5962-9160401					x	x
54AC273	20	Octal D Flip-Flop with MR	D, F, L	5962-8775601	75601	x	x	x		
54AC280	14	9-Bit Parity Generator/Checker	D, F, L	5962-9220101					x	

FACT Logic (cont.)

Device	Leads	Description	Package	SMD/883	JAN* JM38510/	B	S	RHA**	QML-V MIL-S	KGD
FACT AC Ordering Guide, continued										
54AC299	20	Octal Universal Shift Register	D, F, L	5962-8875401	76506	x	x	Pending		
54AC373	20	Octal D Latch with TRI-STATE	D, F, L	5962-8755501	75403	x	x	x		x
54AC374	20	Octal D Flip-Flop with TRI-STATE	D, F, L	5962-8769401	75602	x	x	x		x
54AC377	20	Octal D Flip-Flop with Clock Enable	D, F, L	5962-8870201	75603	x	x			
54AC378	20	Hex D Register with Enable	D, F, L	5962-9160501					x	
54AC520	20	8-Bit Comparator with Pull Ups	D, F, L	5962-9091601	90916	x	x			
54AC521	20	8-Bit Identity Comparator	D, F, L	5962-9098501	90985	x	x	x		
54AC540	20	Octal Buffer/Line Driver w/BroadsidePinout	D, F, L	5962-8769501					x	x
54AC541	20	Octal Buffer/Line Driver w/BroadsidePinout	D, F, L	5962-8870601	75711	x	x	Pending		x
54AC574	20	Octal D Flip-Flop with TRI-STATE	D, F, L	883	75604	x	x	Pending		
54AC646	24	Octal Bus Transceiver/Register	D, F, L	5962-8968201				Pending	x	
54AC821	24	10-Bit D Flip-Flop	D, F, L	5962-9160601					x	
54AC2525	14	Minimum Skew Clock Driver	D, F, L	5962-9217401					x	
54AC2526	14	Minimum Skew Clock Driver	D, F, L	Pending					Pending	
FACT ACT Ordering Guide										
54ACT00	14	Quad 2-Input NAND Gate	D, F, L	5962-8769901	87699	x	x	x		x
54ACT74	14	Dual D Flip-Flop	D, F, L	5962-8752501	87525	x	x			
54ACT109	16	Dual JK Flip-Flop	D, F, L	5962-8853401				Pending	x	
54ACT112	16	Dual JK Negative Edge Trigger	D, F, L	5962-8995001	89950	x	x			
54ACT138	16	1-of-8 Decoder/Demultiplexer	D, F, L	5962-8755401	87554	x	x	Pending	x	x
54ACT139	16	Dual 1-of-4 Decoder/Demultiplexer	D, F, L	5962-8755301					x	x
54ACT151	16	8-Input Multiplexer	D, F, L	5962-8875601	88756	x	x			
54ACT153	16	Dual 4-Input Multiplexer	D, F, L	5962-8769801					x	
54ACT157	16	Quad 2-Input Multiplexer	D, F, L	5962-8953901					x	x
54ACT158	16	Quad 2-Input Multiplexer	D, F, L	5962-8875501					x	x
54ACT161	16	4-Bit Binary Counter Async Reset	D, F, L	5962-9172201					x	
54ACT163	16	4-Bit Binary Counter Sync Reset	D, F, L	5962-9172301					x	
54ACT169	16	4-Bit Binary Up/Down Counter	D, F, L	883					x	
54ACT174	16	Hex D Flip-Flop	D, F, L	5962-8775701				Pending	x	
54ACT175	16	Quad D Flip-Flop	D, F, L	5962-8969301					x	
54ACT240	20	Inverting Octal Buffer/Line Driver	D, F, L	5962-8775901	87759	x	x	x		x
54ACT241	20	Octal Buffer/Line Driver	D, F, L	5962-8984701			x	Pending	x	x
54ACT244	20	Octal Buffer/Line Driver	D, F, L	5962-8776001	87760	x	x	x		x
54ACT245	20	Octal Transceiver	D, F, L	5962-8766301	87663	x	x	x	x	x
54ACT251	16	8-Input Multiplexer with TRI-STATE	D, F, L	5962-8959901					x	
54ACT253	16	Dual 4-Input Multiplexer	D, F, L	5962-8776101					x	x
54ACT257	16	Quad 2-Input Multiplexer	D, F, L	5962-8968901					x	x
54ACT258	16	Quad 2-Input Inverting Multiplexer	D, F, L	5962-8870401					x	x
54ACT283	16	4-Bit Adder	D, F, L	883					x	
54ACT299	20	Octal Universal Shift Register	D, F, L	5962-8877101					x	
54ACT323	20	Octal Universal Shift Register	D, F, L	5962-9160701					x	

FACT Logic (cont.)

Device	Leads	Description	Package	SMD/883	JAN* JM38510/	B	S	RHA**	QML-V MIL-S	KGD
FACT ACT Ordering Guide, continued										
54ACT373	20	Octal D Latch with TRI-STATE	D, F, L	5962-8755601					x	x
54ACT374	20	Octal D Flip-Flop with TRI-STATE	D, F, L	5962-8763101					x	x
54ACT377	20	Octal D Flip-Flop with Clock Enable	D, F, L	5962-8769701	87697	x			x	
54ACT399	16	Quad 2-Port Register	D, F, L	5962-90934•					x	
54ACT520	20	8-Bit Comparator with Pull Ups	D, F, L	5962-8979301					x	
54ACT521	20	8-Bit Identity Comparator	D, F, L	5962-8979302					x	
54ACT534	20	Inverting Octal D Register with TRI-STATE	D, F, L	5962-8965801					x	x
54ACT563	20	Inverting Octal D Latch	D, F, L	5962-8955601					x	
54ACT564	20	Inverting Broadside Octal D Flip-Flop	D, F, L	5962-8955701					x	
54ACT573	20	Octal D Latch, BroadsidePinout	D, F, L	5962 8766401				Pending	x	x
54ACT574	20	Octal D Flip-Flop with Broadside Pinout	D, F, L	5962-8960101	89601	x	x	x		
54ACT715	20	Video Sync Generator	D, L	5962-9309701					x	
54ACT715-R	20	Video Sync Generator	D, L	5962-9309702						
54ACT818	24	8-Bit Diagnostic Register	D, F, L	5962-9160901					x	
54ACT821	24	10-Bit D Flip-Flop with TRI-STATE	D, F, L	5962-8870501					x	
54ACT823	24	9-Bit D Flip-Flop with Clock Enable	D, F, L	5962-9161001					x	
54ACT825	24	8-Bit D Flip-Flop	D, F, L	5962-9161101				Pending		
54ACT899	28	9-Bit Bidirectional Transceiver Generator/Checker	D, L	5962-9314101					x	
54ACT2525	14	Minimum Skew Clock Driver	D, F, L	883					x	

* Where the JAN part number is the same as the SMD part number, this device is available under the One Part-One Part Number DESC drawing system.

** RHA = 100 krad qualification. Contact us for radiation tolerance of non-qualified parts.

• Pending

Package Key:

D = CDIP

F = Ceramic Flatpak

L = Ceramic LCC

FACT Quiet Series™ Logic

Specifically designed for noise-sensitive applications, FACT Quiet Series (FACT QS™) features the lowest ACMOS device-generated noise, low EMI, improved dynamic threshold, very tight output skew, and speeds 15% faster than FACT. 16-bit functions are available for bus driving applications.

Device	Leads	Description	Package	SMD/883	QML-V RHA**	MIL-S	KGD
FACT Quiet Series (ACQ) Ordering Guide							
54ACQ240	20	Inverting Octal Buffer/Line Driver	D, F, L	883		x	x
54ACQ244	20	Octal Buffer/Line Driver	D, F, L	5962-9217601		x	x
54ACQ245	20	Octal Transceiver	D, F, L	5962-9217701		x	x
54ACQ373	20	Octal D Latch with TRI-STATE	D, F, L	5962-9217801		x	x
54ACQ374	20	Octal D Flip-Flop with TRI-STATE	D, F, L	5962-9217901		x	x
54ACQ573	20	Octal D Latch, Broadside Pinout	D, F, L	5962-9218001		x	x
FACT Quiet Series (ACTQ) Ordering Guide							
54ACTQ02	14	Quad 2-Input NOR Gate	D, F, L	5962-9218101		x	x
54ACTQ04	14	Hex Inverter	D, F, L	5962-8973401	x	x	x
54ACTQ08	14	Quad 2-Input AND Gate	D, F, L	5962-8954702	x	x	x
54ACTQ10	14	Triple 3-Input NAND Gate	D, F, L	5962-9218201		x	x
54ACTQ14	14	Hex Inverter with Schmitt Trigger	D, F, L	5962-9218301		x	
54ACTQ32	14	Quad 2-Input OR Gate	D, F, L	5962-8973601	x, RHA	x	x
54ACTQ240	20	Inverting Octal Buffer/Line Driver	D, F, L	5962-9218401		x	x
54ACTQ241	20	Octal Buffer/Line Driver	D, F, L	5962-9218501	x	x	x
54ACTQ244	20	Octal Buffer/Line Driver	D, F, L	5962-9218601	x	x	x
54ACTQ245	20	Octal Transceiver	D, F, L	5962-9218701		x	x
54ACTQ273	20	Octal D Flip-Flop with MR	D, F, L	5962-8973501	x	x	
54ACTQ373	20	Octal D Latch with TRI-STATE	D, F, L	5962-9218801	Pending	x	x
54ACTQ374	20	Octal D Flip-Flop with TRI-STATE	D, F, L	5962-9218901	Pending	x	x
54ACTQ377	20	Octal D Flip-Flop with Clock Enable	D, F, L	5962-9219001		x	
54ACTQ533	20	Inverting Octal D Latch	D, F, L	5962-92919•		x	x
54ACTQ541	20	Octal Buffer/Line Driver w/Broadside Pinout	D, F, L	5962-9682901			
54ACTQ543	24	Octal Transceiver/Latch	D, F, L	5962-92192•			
54ACTQ544	24	Octal Transceiver/Latch	D, F, L	5962-92193•			
54ACTQ573	20	Octal D Latch, Broadside Pinout	D, F, L	5962-9219401		x	x
54ACTQ574	20	Octal D Flip-Flop, Broadside Pinout	D, F, L	5962-92195•		x	x
54ACTQ646	24	Octal Register/Transceiver	D, F, L	5962-9219601		x	

FACT Quiet Series Logic (cont.)

Device	Leads	Description	Package	SMD/883	QML-V RHA**	MIL-S	KGD
FACT Quiet Series (ACTQ) Ordering Guide, continued							
54ACTQ657	24	Bidirectional Transceiver with Parity	D, F, L	5962-9219701		x	
54ACTQ821	24	10-Bit Flip-Flop	D, F, L	5962-92198•		x	
54ACTQ827	24	10-Bit Buffer	D, F, L	5962-9219901		x	
54ACTQ841	24	10-Bit D Latch	D, F, L	5962-9220001		x	
54ACTQ16240	48	16-Bit Inverting Buffer/Line Driver	F	5962-9688001†			x
54ACTQ16244	48	16-Bit Buffer/Line Driver	F	5962-9561901†	x	x	x
54ACTQ16245	48	16-Bit Transceiver	F	5962-9562001†		x	x
54ACTQ16373	48	16-Bit D Latch with TRI-STATE	F	5962-9561801†		x	x
54ACTQ16374	48	16-Bit D Flip-Flop with TRI-STATE	F	5962-9452801†		x	x
54ACTQ16540	48	16-Bit Buffer/Driver	F	883			x
54ACTQ16541	48	16-Bit Buffer/Driver	F	883			x
54ACTQ16646	56	16-Bit Register/Transceiver	F	5962-9581601†		Pending	x

• Pending

† Qualified under QML as SMD

** RHA = 100 krad qualification. Contact us for radiation tolerance of non-qualified parts.

Package Key:

D = CDIP

F = Ceramic Flatpak

L = Ceramic LCC

FACT FCT Logic

Offering 7ns speeds, FACT FCT is a high-performance, high-drive family that consists primarily of octal functions. Its features include enhanced noise immunity that surpasses the competition. FACT FCT has a TTL-to-CMOS input buffer stage and is designed to interface with TTL outputs.

Device	Leads	Description	Package	SMD/883	QML-V MIL-S	KGD
FACT FCT Ordering Guide						
54FCT138	16	1-of-8 Decoder	D, F, L	5962-8765401	x	x
54FCT240	20	Inverting Octal Buffer/Line Driver	D, F, L	5962-8765501	x	x
54FCT241	20	Octal Buffer/Line Driver	D, F, L	883		x
54FCT244	20	Octal Buffer/Line Driver	D, F, L	5962-8763001	x	x
54FCT245	20	Octal Transceiver	D, F, L	5962-8762901		x
54FCT273	20	Octal D Flip-Flop with MR	D, F, L	5962-8765601	x	
54FCT373	20	Octal D Latch with TRI-STATE	D, F, L	5962-8764401		x
54FCT374	20	Octal D Flip-Flop with TRI-STATE	D, F, L	5962-8762801	x	x
54FCT377	20	Octal D Flip-Flop with CE	D, F, L	5962-8762701	x	
54FCT521	20	8-Bit Identity Comparator	D, F, L	5962-8854301	x	
54FCT533	20	Inverting Octal D Latch	D, F, L	5962-8865101		x
54FCT540	20	Octal Buffer/Line Driver w/Broadside Pinout	D, F, L	5962-8976701	x	x
54FCT541	20	Octal Buffer/Line Driver w/Broadside Pinout	D, F, L	5962-8976601	x	x
54FCT573	20	Octal D Latch, Broadside Pinout	D, F, L	5962-8863901		x
54FCT574	20	Octal D Flip-Flop with Broadside Pinout	D, F, L	5962-8951301	x	x

Package Key:

D = CDIP

F = Ceramic Flatpak

L = Ceramic LCC

F100K 300 Series ECL Logic

National Semiconductor's 300 Series ECL is the easiest-to-use ECL with the lowest power and best price/performance of any ECL family. Having 100K ECL speed and performance, 300 Series consumes up to 50% less operating power, guarantees 2,000 volt ESD protection, tests output skew specification, and has a stable I/O over a wide range of voltages and temperatures. It is the logic of choice for ECL-based systems as well as those that mix ECL with TTL and/or CMOS. 300 Series ECL is a socket replacement for the 100 Series, and offers inherent Total Dose Radiation tolerance.

Device	Leads	Description	Package	SMD/883	QML-V MIL-S
F100K 300 Series ECL Ordering Guide					
100301	24, 28	Triple 5-Input OR/NOR Gate	D, F	5962-9152801	QML-V
100302	24, 28	Quint 2-Input OR/NOR Gate	D, F	5962-9152802	QML-V
100304	24, 28	Quint AND/NAND Gate	D, F	5962-9153701	QML-V
100307	24, 28	Quint Exclusive OR/NOR Gate	D, F	5962-9459001	QML-V
100313	24, 28	Quad Driver	D, F	5962-9673201	x
100314	24, 28	Quint Receiver	D, F	5962-9162901	QML-V
100315	16	Minimum Skew Clock Driver	F	5962-9469601	x
100321	24, 28	9-Bit Inverter	D, F	883	
100322	24, 28	9-Bit Buffer	D, F	883	x
100323	24, 28	Hex Bus Driver	D, F	883	x
100324	24, 28	Hex TTL-to-ECL Translator	D, F	5962-9153001	QML-V
100325	24, 28	Hex ECL-to-TTL Translator	D, F	5962-9153101	QML-V
100328	24, 28	Bidirectional ECL-to-TTL Translator	D, F	883	x
100329	24, 28	Bidirectional ECL-to-TTL Translator	D, F	5962-9206601	x
100331	24, 28	Triple D Flip-Flop	D, F	5962-9153001	QML-V
100336	24, 28	4-Bit Counter/Shift Register	D, F	5962-9230601	QML-V
100341	24, 28	Octal Shift Register	D, F	5962-9459101	QML-V
100343	24, 28	8-Bit Latch	D, F	883	x
100344	24, 28	8-Bit Latch with Cutoff Drivers	D, F	883	x
100351	24, 28	Hex D Flip-Flop	D, F	5962-9457901	QML-V
100352	24, 28	8-Bit Buffer w/Cut-Off Drivers	D, F	883	x
100353	24, 28	Octal Register (50Ω Drive)	D, F	883	x
100355	24, 28	Quad Multiplexer/Latch	D, F	5962-9165401	QML-V
100363	24, 28	Dual 8-Input Multiplexer	D, F	5962-9165501	x
100364	24, 28	16-Input Multiplexer	D, F	5962-9459201	QML-V
100370	24, 28	Universal Demultiplexer/Decoder	D, F	883	x
100371	24, 28	Triple 4-Input Multiplexer w/Enable	D, F	883	x

SCAN System & Board Test Products (IEEE 1149.1)

National's portfolio of SCAN test products lowers a system's cost of ownership over the course of its life cycle. SCAN products enable faster manufacturing board test, system check out, and in-field diagnostics and repair. All products conform to the IEEE 1149.1 Standard established by the Joint Test Action Group (JTAG).

- The low power of SCAN CMOS Test Access Logic makes it ideal to surround non-JTAG-compliant devices for board-level test.
- The SCAN PSC100F enables the use of a microprocessor to create an on-board embedded Test Master, freeing up external test equipment.
- SCANPSC110F enables simultaneous testing of like boards as well as partitioning of complex systems. Use it on each board in a multi-drop or hierarchical system design.

Device	Leads	Description	Package	SMD/883	KGD
SCAN Ordering Guide					
SCAN18245T	56	18-Bit Bidirectional Transceiver with 1149.1	F	5962-9311501	x
SCAN18373T	56	18-Bit Latch with 1149.1	F	5962-9311801	x
SCAN18374T	56	18-Bit Flip-Flop with 1149.1	F	5962-9320701	x
SCAN18540T	56	18-Bit Inverting Buffer with 1149.1	F	5962-9312701	x
SCAN18541T	56	18-Bit Buffer with 1149.1	F	5962-9311601	x
SCANPSC100F	28	Embedded Boundary Scan Controller	D, F, L	5962-9475001	x
SCANPSC110F	28	SCAN Bridge (IEEE 1149.1 Hierarchal & Multidrop Addressable JTAG Port)	D, F, L	883	x

Package Key:

D = CDIP

F = Ceramic Flatpak

L = Ceramic LCC

Product Availability Guide by Function

	Bipolar			BiCMOS	CMOS						
	FAST	LS	TTL	ABT	AC	ACQ	ACT	ACTQ	C	FCT	HC
Function											
00	•	•	•		•		•		•		
01			•								
02	•	•	•		•			•			
03		•	•								
04	•	•	•		•			•	•		
05		•			•						
06			•								
07			•								
08	•	•	•		•			•	•		
09			•								
10	•	•	•		•			•			
11	•	•			•						
13	•										
14	•	•	•		•			•	•		
15		•									
16			•								
17			•								
20	•	•	•		•						
21		•									
27		•									
30		•	•						•		
32	•	•			•			•			
37			•								
38	•		•								
40			•								
42		•	•						•		
47			•								
49											
51		•	•								
54		•									
64	•										
73		•									
74	•	•	•		•		•		•		
76			•						•		
83		•	•								
85		•							•		
86	•	•	•		•				•		
90			•						•		
95			•								
97			•								
109	•	•			•		•				
112							•				
113		•									
121			•								
122			•								
123			•								•
125		•	•		•						
132	•										
133		•									
138	•	•			•		•			•	
139	•	•			•		•				
150			•								
151	•	•	•		•		•		•		
153	•	•	•		•		•				
154		•	•								

Product Availability Guide by Function

	Bipolar			BiCMOS	CMOS						
	FAST	LS	TTL	ABT	AC	ACQ	ACT	ACTQ	C	FCT	HC
Function											
157	•	•	•		•		•		•		
158	•	•			•		•				
160	•										
161	•	•	•		•				•		
163	•		•		•						
164	•	•							•		
165		•	•								
168		•									
169	•	•			•		•				
173			•								
174	•	•	•		•		•		•		
175	•	•	•		•		•		•		
180			•								
181	•										
182	•										
189	•										
190	•										
191	•		•		•						
192											
193	•	•							•		
194	•	•	•								
195		•							•		
219	•										
221									•		
240		•		•	•	•	•	•		•	
241	•	•		•	•		•	•		•	
243	•										
244	•	•		•	•	•	•	•		•	
245	•	•		•	•	•	•	•		•	
251	•	•			•		•				
253	•	•			•		•				
257	•	•			•		•				
258	•	•			•		•				
259		•									
260		•									
273	•	•		•	•		•	•		•	
279		•	•								
280	•				•						
283		•	•				•				
295		•									
298		•	•								
299	•	•			•		•				
322	•										
323	•						•				
365	•	•									
366		•									
367		•	•								
368		•									
373	•	•		•	•	•	•	•	•	•	
374	•	•		•	•	•	•	•	•	•	

• = Available

Product Availability Guide by Function

	Bipolar			BiCMOS	CMOS						
	FAST	LS	TTL	ABT	AC	ACQ	ACT	ACTQ	C	FCT	HC
Function											
377	•	•		•	•		•	•		•	
378	•				•						
379	•										
398	•										
399	•						•				
402	•										
403	•										
407	•										
410	•										
413	•										
447		•									
502		•									
503		•									
520					•		•				
521	•				•		•			•	
533	•							•		•	
534	•						•				
540	•				•					•	
541				•	•			•		•	
543				•				•			
544	•							•			
545	•										
563	•						•				
564	•						•				
573	•			•		•	•	•		•	
574	•			•	•		•	•		•	
646	•			•	•			•			
648	•										
651	•										
652	•			•							
670		•									
657	•							•			
676	•										
715								•			
715-R								•			
818							•				
821	•				•		•	•			
823	•						•				
825	•						•				
827	•							•			
841								•			
899				Pend						•	
902									•		
906									•		
907									•		
914									•		
922									•		
2241	•										
2243	•										
2244	•			Pend							
2245										•	

Product Availability Guide by Function

Bipolar			BiCMOS	CMOS						
FAST	**LS**	**TTL**	**ABT**	**AC**	**ACQ**	**ACT**	**ACTQ**	**C**	**FCT**	**HC**
Function										
2525				•		•				
2526				Pend						
16240							•			
16244			•				•			
16245			•				•			
16373			•				•			
16374			•				•			
15500			•							
16540							•			
16541							•			
16646			•				•			
96L02		•								

• = Available

HCMOS to Recommended FACT AC Upgrade

HCMOS Device	Function Description	Functional Replacement
MM54HC00	NAND Gate	54AC00
MM54HC02	NOR Gate	54AC02
MM54HC03	NAND Gate	54AC03
MM54HC04	Inverter	54AC04
MM54HC08	AND Gate	54AC08
MM54HC10	NAND Gate	54AC10
MM54HC14	Schmitt Trigger	54AC14
MM54HC32	OR Gate	54AC32
MM54HC42	Decoder	MM54C42
MM54HC73	Flip-Flop	None
MM54HC74	Flip-Flop	54AC74
MM54HC75	Latch	None
MM54HC76	Flip-Flop	MM54C76
MM54HC85	Comparator	MM54C85
MM54HC86	OR Gate	54AC86
MM54HC123	Dual Retriggerable	Available from National
MM54HC125	Buffer Gate	54LS125
MM54HC126	Buffer Gate	None
MM54HC132	Schmitt Trigger	54F132
MM54HC138	Demultiplexer	54AC138
MM54HC139	Demultiplexer	54AC139
MM54HC147	Decoder	None
MM54HC151	Multiplexer	54AC151
MM54HC153	Multiplexer	54AC153
MM54HC154	Demultiplexer	54LS154
MM54HC157	Multiplexer	54AC157
MM54HC161	Counter	54AC161
MM54HC163	Counter	54AC163
MM54HC164	Register	MM54C164
MM54HC165	Register	54LS165
MM54HC174	Flip-Flop	54AC174
MM54HC175	Flip-Flop	54AC175
MM54HC193	Counter	MM54C193
MM54HC221A	Multivibrator	MM54C221
MM54HC240	Buffer/Driver	54AC240
MM54HC244	Buffer/Driver	54AC244

HCMOS Device	Function Description	Functional Replacement
MM54HC245	Transceiver	54AC245
MM54HC257	Multiplexer	54AC257
MM54HC259	Latch	54LS259
MM54HC273	Flip-Flop	54AC273
MM54HC283	Adder	54ACT283
MM54HC298	Multiplexer	54LS198
MM54HC299	Register	54AC299
MM54HC365	Buffer	54F365
MM54HC373	Latch	54AC373
MM54HC374	Flip-Flop	54AC374
MM54HC390	Counter	None
MM54HC393	Counter	None
MM54HC423A	Multivibrator	None
MM54H563	Latch	54ACT563
MM54HC564	Flip-Flop	54ACT564
MM54HC573	Latch	54ACQ573
MM54HC574	Flip-Flop	54ACQ574
MM54HC640	Transceiver	None
MM54HC646	Transceiver	54AC646
MM54HC688	Comparator	None
MM54HC4017	Counter	None
MM54HC4020	Counter	None
MM54HC4040	Counter	None
MM54HC4049	Converter	None
MM54HC4050	Converter	None
MM54HC4511	Driver	None
MM54HC4514	Decoder	None
MM54HC4538	Multivibrator	None
MM54HCT138	Demultiplexer	54ACT138
MM54HCT241	Driver	54ACT241
MM54HCT244	Driver	54ACT244
MM54HCT245	Transceiver	54ACT245
MM54HCT373	Latch	54ACT373
MM54HCT374	Flip-Flop	54ACT374
MM54HCT688	Comparator	None

CD4K Availability and Recommended Upgrade

CD4K Device	Function Description	Functional Replacement	Pin for Pin Compatible?
4001	NOR Gate	54AC02	No
4011	NAND Gate	54AC00	No
4013	D Flip-Flop	54AC74	No
4023	NAND Gate	54AC10	No
4027	J-K Flip-Flop	None	
4028	Decoder	None	
4029	Counter	54AC191	No
4040	12-Bit Counter	None	
4047	Multivibrator	None	
4049	Hex Buffer	54AC04	No
4050	Hex Buffer	None	
4051	Analog Multiplexer/Demultiplexer	None	
4052	Analog Multiplexer/Demultiplexer	None	
4053	Analog Multiplexer/Demultiplexer	None	
4060	Counter	None	
4069	Hex Inverter	54AC04	Yes
4070	Exclusive-OR Gate	54AC86	No
4071	OR Gate	54AC32	No
4081	AND Gate	54AC08	No
4093	NAND Gate	None	
40106	Schmitt Trigger	54AC14	Yes
40161	Binary Counter	54AC161	Yes
40163	Binary Counter	54AC163	Yes
40174	D Flip-Flop	54AC174	Yes
40175	D Flip-Flop	54AC175	Yes
40193	Up/Down Counter	None	
4528	Multivibrator	None	
4724	Latch	None	

National Semiconductor

Memory

Memory Table of Contents

National Semiconductor provides the highest speed, highest performance, and most power conservative CMOS asynchronous 0.35µ SRAMs. The products listed in this section are in the process of being qualified as Standard Military Drawings (SMDs). Upcoming availability will be in ceramic packages as well as Known Good Die. For availability status, please contact your National or Distributor sales representative.

SRAM Family Features

- Fast access times
- Single 5V or 3.3V power supply (± 10%)
- Fully static – no clock or timing strobes necessary
- All inputs and outputs are TTL compatible
- TRI-STATE outputs
- Center power and ground pins afford greater noise immunity
- JEDEC standard for functionality and revolutionary pinout
- Easy memory expansion
- Automatic power down
- High-performance, low-power consumption, CMOS double-layer polysilicon, double-layer metal technology

Device	Leads	Description	Package	SMD/883	KGD
SRAM Ordering Guide					
NS31024	32	15ns, 3.3V, 128K x 8 Asynchronous SRAM	D, E, F, Y	TBA	5/98
NS31096	36	15ns, 3.3V, 512K x 8 Asynchronous SRAM	D, F, SOJ	TBA	5/98
NS32024	44	15ns, 3.3V, 64K x 16 Asynchronous SRAM	F, SOJ	TBA	Pending
NS32096	44	15ns, 3.3V, 256K x 16 Asynchronous SRAM	F, SOJ	5/98	5/98
NS41024	32	15ns, 5V, 128K x 8 Asynchronous SRAM	D, E, F, Y	12/97	12/97
NS41096	36	15ns, 5V, 512K x 8 Asynchronous SRAM	D, F, SOJ	5/98	5/98
NS42024	44	15ns, 5V, 64K x 16 Asynchronous SRAM	F, SOJ	TBA	Pending
NS42096	44	15ns, 5V, 256K x 16 Asynchronous SRAM	F, SOJ	5/98	5/98

D = Ceramic Sidebraze DIP

E = Ceramic Leadless Chip Carrier (Quad Leads)

F = Flatpak

Y = Ceramic Leadless Chip Carrier (Dual Leads)

SOJ = Small Outline J - Lead

National Semiconductor

ARINC, LAN/WAN, Microcontroller & Wireless

ARINC, LAN/WAN, Microcontroller & Wireless Table of Contents

National Semiconductor offers a broad portfolio of ARINC, LAN/WAN, Microcontroller, and Wireless products that support military process flows. All microcontroller products are available with the development tools you need to write, assemble, debug, and emulate software for your target microcontroller.

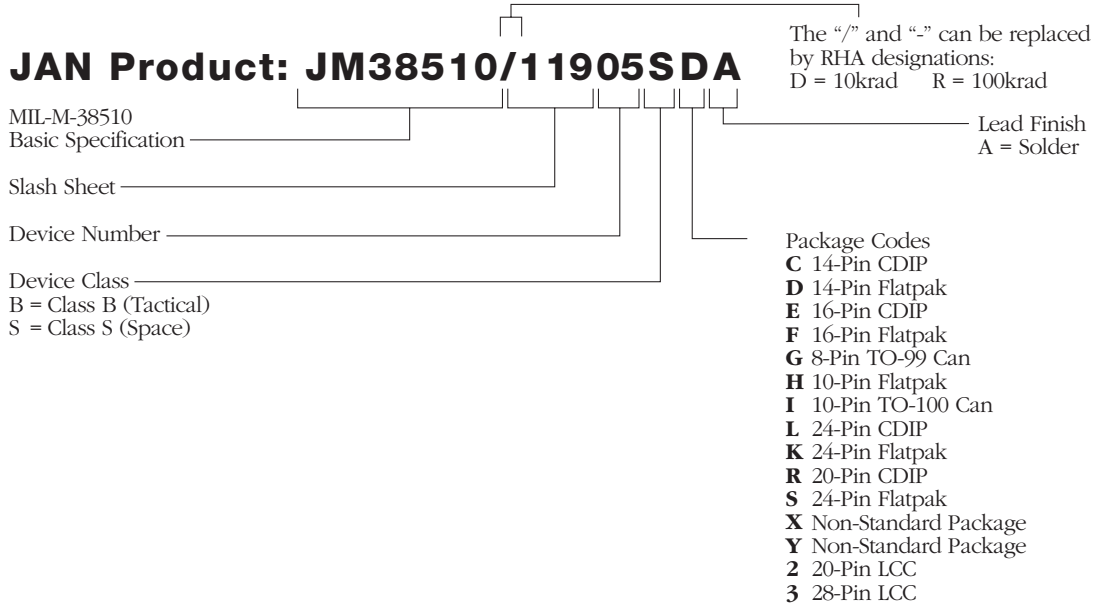
ARINC, LAN/WAN, Microcontroller & Wireless (cont.)

Device	Leads	Description	Packages	Qualification
ARINC Ordering Guide				
AR629A	180	ARINC Bus Terminal Controller	U9	/883, MC1
LAN/WAN Ordering Guide				
DP83257	160	FDDI (PLAYER+)	VF	MPC
DP83266	160	FDDI (MACSI)	VF	MPC
DP83932B	132	Ethernet (SONIC)	VF	MPC
DP83950B	160	Ethernet (RIC)	VQB	MPC
Microcontrollers Ordering Guide				
4 Bit				
COP244C	28	2.0k ROM, 128 x 4 RAM, 23 I/O	J	/883
8 Bit				
COP640C	28	2.0k ROM, 128k RAM, 23 I/O	J	Mil Temp
COP681C	28	4.0k ROM, 128k RAM, 23 I/O	J	/883
Wireless Ordering Guide				
LMX2315	20	1.2GHz PLL	WG	2Q98
LMX2320	20	2.0GHz PLL	WG	2Q98
LMX2325	20	2.5GHz PLL	WG	2Q98
LMX9301	20	Low Temperature Co-Fired Ceramic (LTCC) Frequency Synthesizer	Custom	TBD

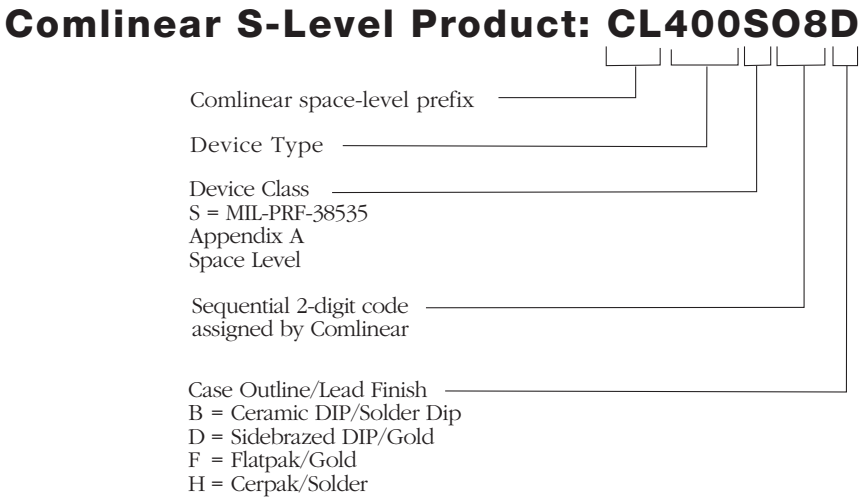
Package Key:

- J = Ceramic DIP
- U9 = Ceramic PGA
- VF = Plastic Quad Flatpak
- VQB = Plastic Quad Flatpak
- WG = Ceramic SOIC

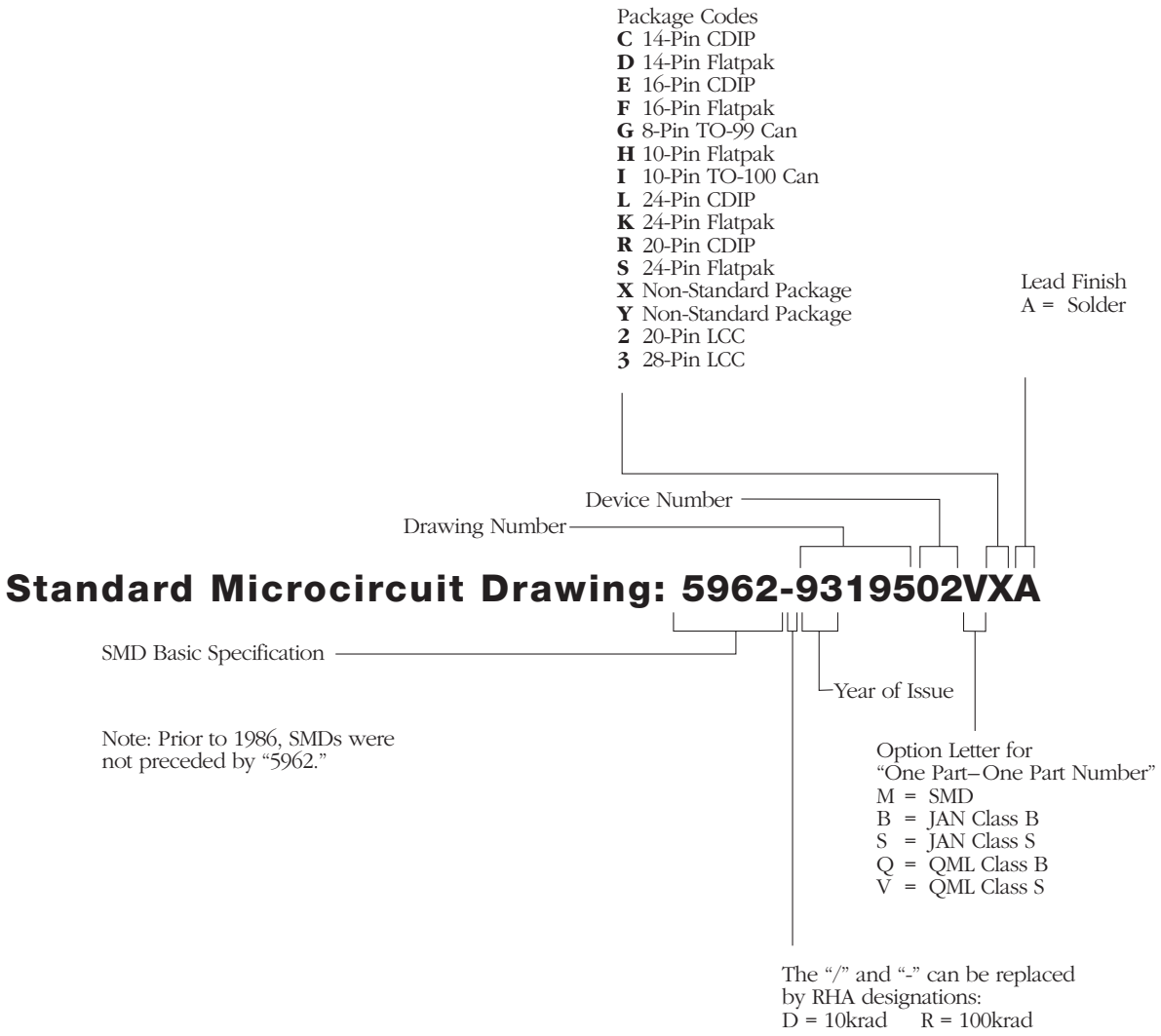
Part Numbering Guides



Comlinear Part Numbering Guide



Part Numbering Guides



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Fax Number . . . . . +49(0)180 530 8586
Email ID . . . . . europe.support@nsc.com

European Mil/Aero Marketing

Telephone . . . . . +49(0)8141 351492
. . . . . +49(0)8141 351495
Fax Number . . . . . +49(0)8141 351470

Japan

Jepico . . . . . (03) 3348-0611

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Collateral

Description	Lit. #
Line Cards	
Products & Services	650217-001
Technologies for Space, 1996	650271-002
Known Good Die/Die Processing	650215-004
Databooks	
ABT Databook, 1996	400001
FACT Logic Databook	400022
F100K 300 Series Databook	400027
Application-Specific Analog Products Databook	400034

Description	Lit. #
Databooks, cont.	
Data Acquisition Databook	400035
Operational Amplifiers Databook	400036
Power IC Databook	400037
Interface Databook, 1996	400045
SCAN Databook, 1996	400103
Comlinear Databook	450002
Packaging Databook, 1993	400075