

The World Leader in High Performance Signal Processing Solutions



iCoupler[®] Isolation Technology

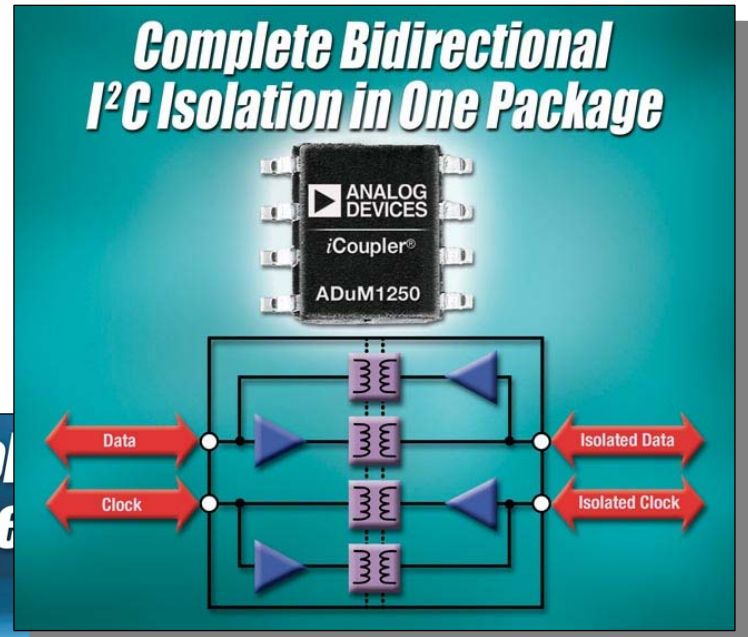
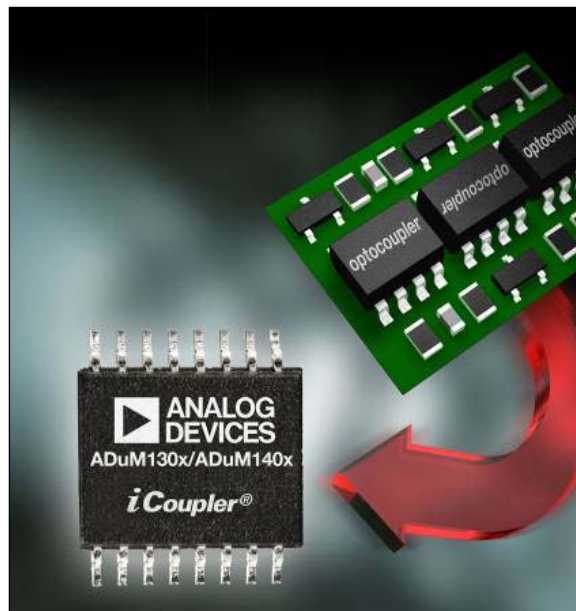


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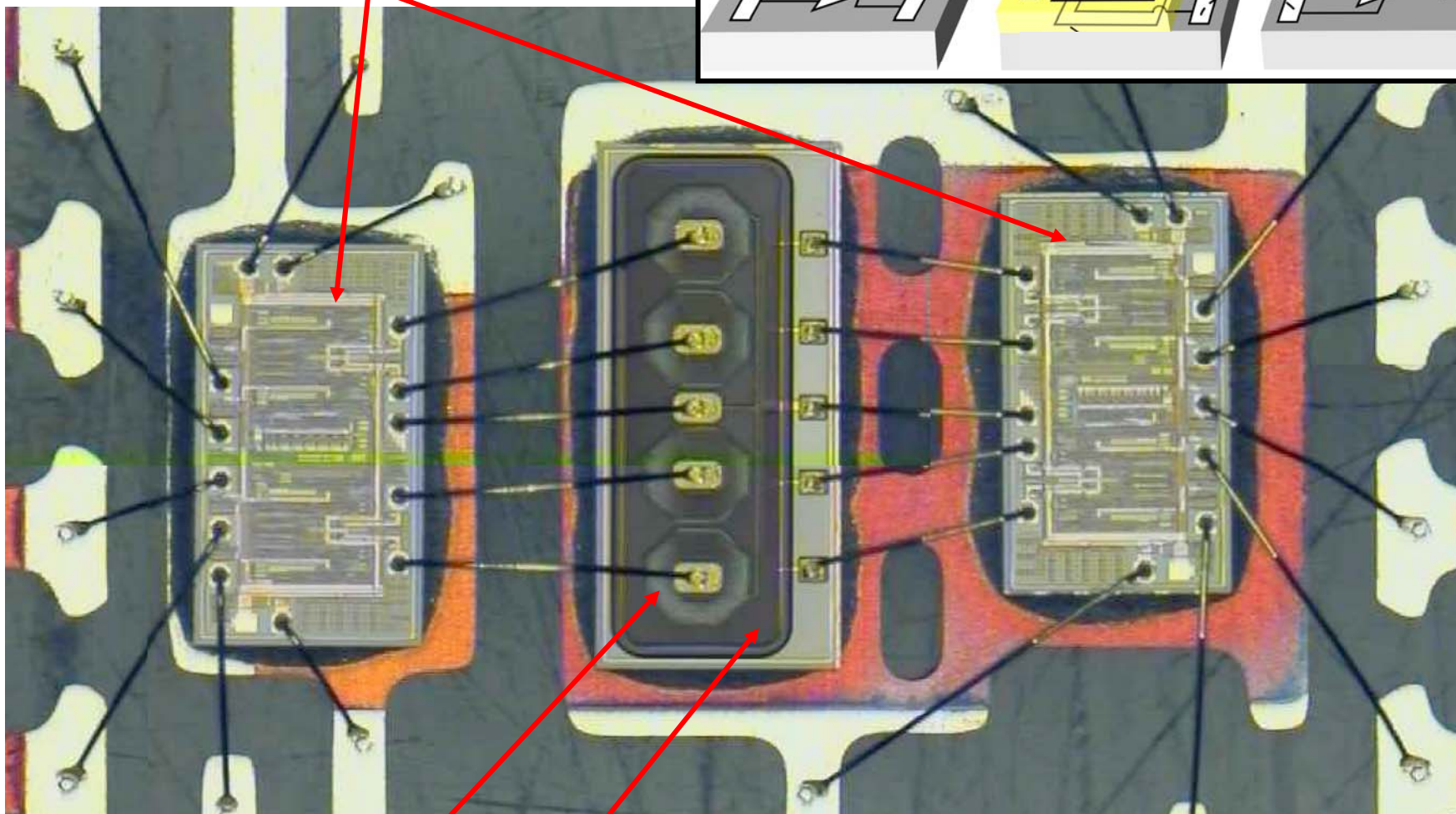
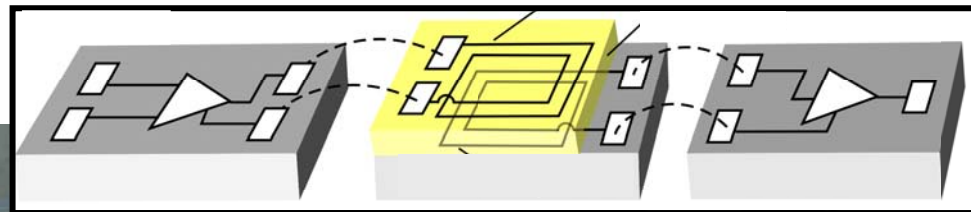
iCoupler Technology – Advancing Beyond Optocouplers

- ◆ *Integration*
- ◆ *Performance*
- ◆ *Power Consumption*
- ◆ *Ease-of-Use*
- ◆ *Reliability*



ADuM140x Quad Isolator

CMOS interface chips contain drive and receive circuits

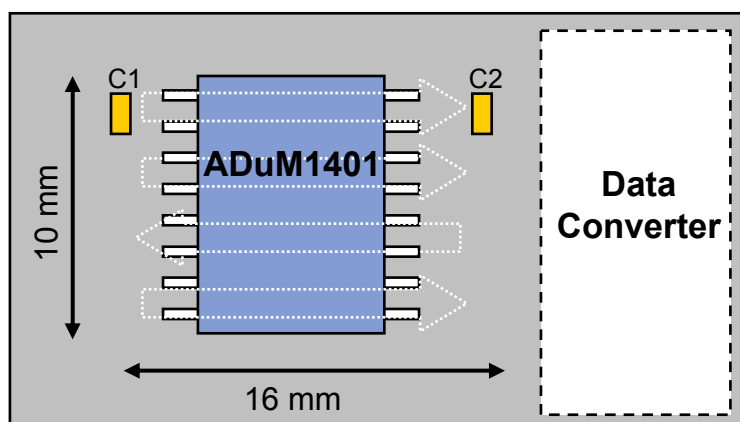


iCoupler transformers support communication in either direction

Polyimide insulation layers enable 2.5-5.0 kV isolation rating

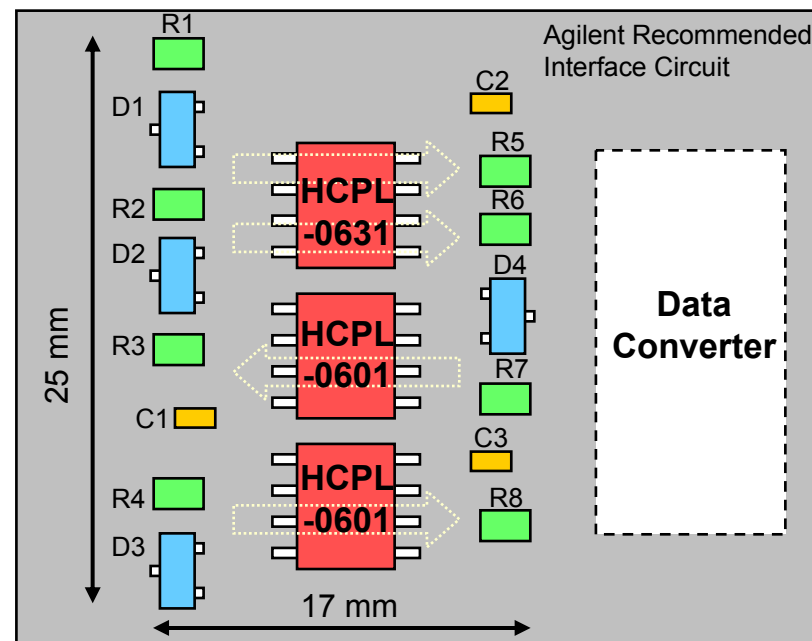
Integration Benefits – 30-60% Cost/Size Reduction

iCoupler Solution



Component Count:	3
Board Area:	160 sq mm
Total Cost:	\$2.55
ADuM1401B:	\$2.40
Discretes (2):	\$0.03
Placement Costs:	\$0.12

Optocoupler Solution



Component Count:	18
Board Area:	425 sq mm
Total Cost:	\$3.55
HCPL-0601 (2):	\$1.40
HCPL-0631:	\$1.40
Discretes (15):	\$0.21
Placement Costs:	\$0.54

Performance Benefits – Data Rate & Timing

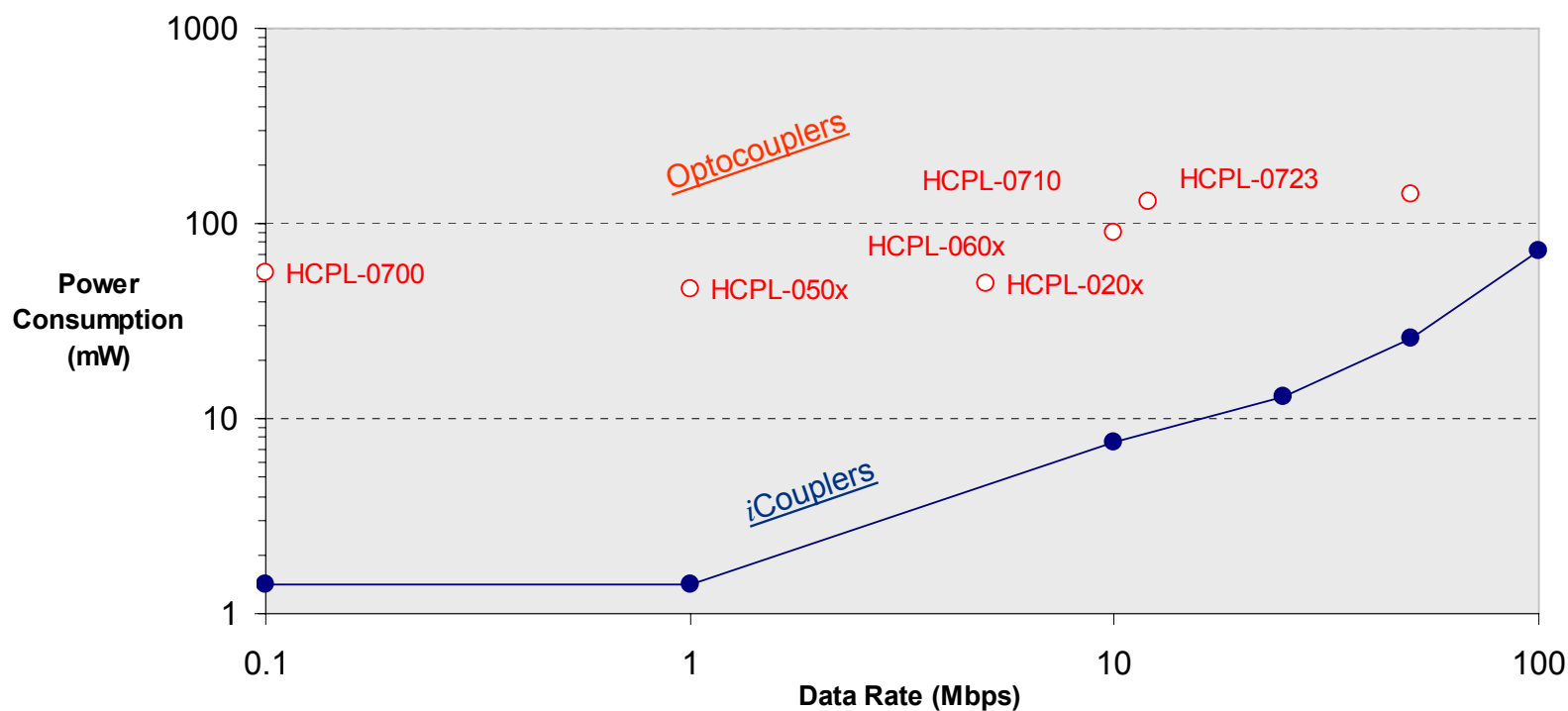
◆ High-Speed

Parameter	Avago HCPL-0710 Optocoupler	Avago HCPL-0723 Optocoupler	Analog Devices ADuM1100BR iCoupler
Max. Data Rate (Mbps)	12.5	50	100
Prop. Delay (ns)	40	22	18
Part-to-Part Match (ns)	20	16	8
Pulse Width Distortion (ns)	8	2	2

◆ Medium-Speed

Parameter	Avago HCPL-063x Dual Optocoupler	Analog Devices ADuM1200BR Dual iCoupler
Max. Data Rate (Mbps)	10	10
Prop. Delay (ns)	100	50
Part-to-Part Match (ns)	40	15
Channel-to-Channel Match (ns)	unspecified	3
Pulse Width Distortion (ns)	35	3

Power Consumption Benefits – Up to 98% Reduction!



Reduced Power Consumption Results in:

- *Reduced Heat Dissipation*
- *Improved Reliability*
- *Reduced Performance Variation*
- *Reduced Cost*



Ease-of-Use Benefits

iCouplers Operate as Standard Digital CMOS Components

- Low Temperature Sensitivity
- High Reliability
- Standard CMOS/TTL Interfaces
- No Derating, Variation Over Time

Parameter	Optocouplers	Analog Devices <i>iCoupler</i>
Interfaces	Analog	Digital
External Components	Pull-up resistors + caps	Bypass caps only
Current Transfer Ratio	<ul style="list-style-type: none">• Wide range of values• Varies over time and temp	(not applicable)
Max. Operating Temperature	85 °C (usually)	105 °C and 125 °C
Prop. Delay vs. Temperature	0.1 - >1 ns/°C	0.03 ns/°C
Voltage Translation	--	2.7V to 5.5V
Common-Mode Transient Immunity	Unspecified to 10 kV/μs	25 kV/μs



Reliability Benefits

Parameter	Optocouplers	Analog Devices <i>i</i> Couplers	
Active Devices	LEDs, Photodiodes, (Silicon Transistors)	0.6 micron CMOS	<ul style="list-style-type: none"> • No LED Wearout • FIT Rate <10
Insulation	Discrete, Assembly-Level	Polyimide, Wafer-Level	<ul style="list-style-type: none"> • Semiconductor clean-room environment, control, and consistency
Thermal Dissipation	50 - 200 mW per channel	1 - 10 mW per channel (data rates < 10 Mbps)	<ul style="list-style-type: none"> • Increased lifetime • Negligible heating of adjacent components

- ◆ ***i*Coupler Products Have the Same Safety Approvals as High-Quality Optocouplers (UL, CSA, VDE)**
- ◆ **100% Production Testing is Performed at 3.0KV_{RMS}**

iCoupler Safety Requirements Compliance

- Approval Issued
- Approval Pending

Reports available at:
www.analog.com/icouplersafety

Agency	Standard	Max. Working Voltage	Isolation Rating/ Transient Overvoltage	Insulation Type	ADuM1100/3100	ADuM120x/1210/320x	ADuM130x/131x	ADuM140x/141x	ADuM330x/340x	ADM2486/2483	ADuM240x	ADuM1230	AD7400/7401	ADuM524x	ADuM1250/1251
UL	UL 1577	--	2.5 KV _{RMS}	Basic	●	●				●		●		○	●
		--	2.5 KV _{RMS}	Reinforced			●	●	●						
		--	3.75 KV _{RMS}	Basic									●		
		--	5.0 KV _{RMS}	Reinforced							●				
CSA	CSA/IEC 60950-1	300 V _{RMS}	2.5 KV _{RMS}	Basic	●	●								○	●
	CSA/IEC 60950-1	800 V _{RMS}	2.5 KV _{RMS}	Basic			●	●	●	●					
	CSA/IEC 60950-1	400 V _{RMS}	2.5 KV _{RMS}	Reinforced			●	●	●	●					
	CSA/IEC 60950-1	630 V _{RMS}	3.75 KV _{RMS}	Reinforced									●		
	CSA/IEC 61010-1	400 V _{RMS}	5.0 KV _{RMS}	Reinforced							●				
	IEC 60601-1	250 V _{RMS}	5.0 KV _{RMS}	Reinforced							●				
	CSA/IEC 60950-1	600 V _{RMS}	5.0 KV _{RMS}	Reinforced							●				
VDE	DIN EN 60747-5-2	400 V _{RMS}	4.0 KV _{PK}	Basic	●	●	●	●	●	●				○	●
		600 V _{RMS}	6.0 KV _{PK}	Basic							●				
		630 V _{RMS}	6.0 KV _{PK}	Basic									●		
	DIN EN 60747-5-5	400 V _{RMS}	4.0 KV _{PK}	Reinforced			○	○	○						
		600 V _{RMS}	6.0 KV _{PK}	Reinforced							○				
		630 V _{RMS}	6.0 KV _{PK}	Reinforced									○		
TÜV	CSA/UL/IEC 61010-1	400 V _{RMS}	2.7 KV _{RMS}	Reinforced			●	●							
		600 V _{RMS}	5.0 KV _{RMS}	Reinforced							○				

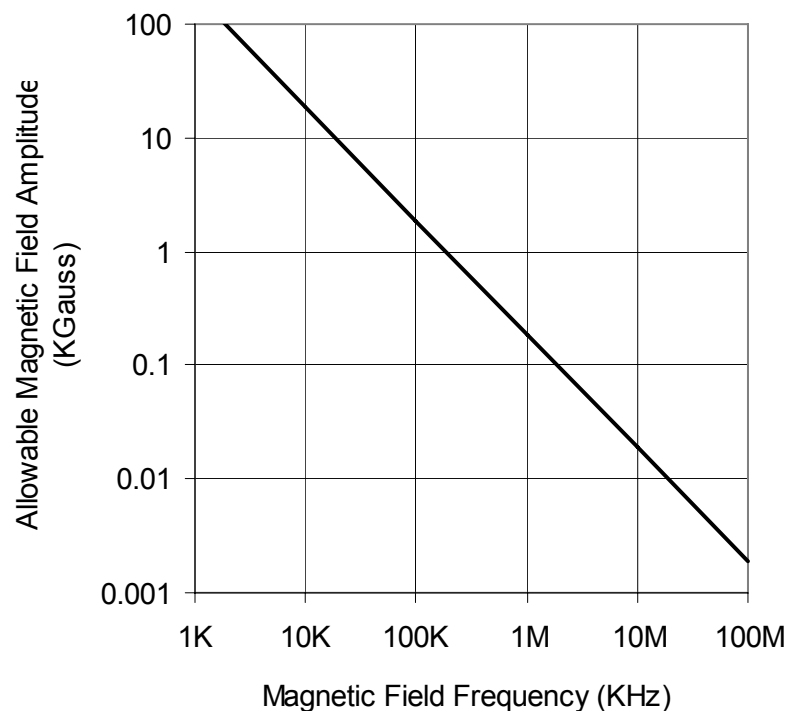
VDE Reinforced Insulation Approval

◆ iCoupler Products Successfully Tested by VDE

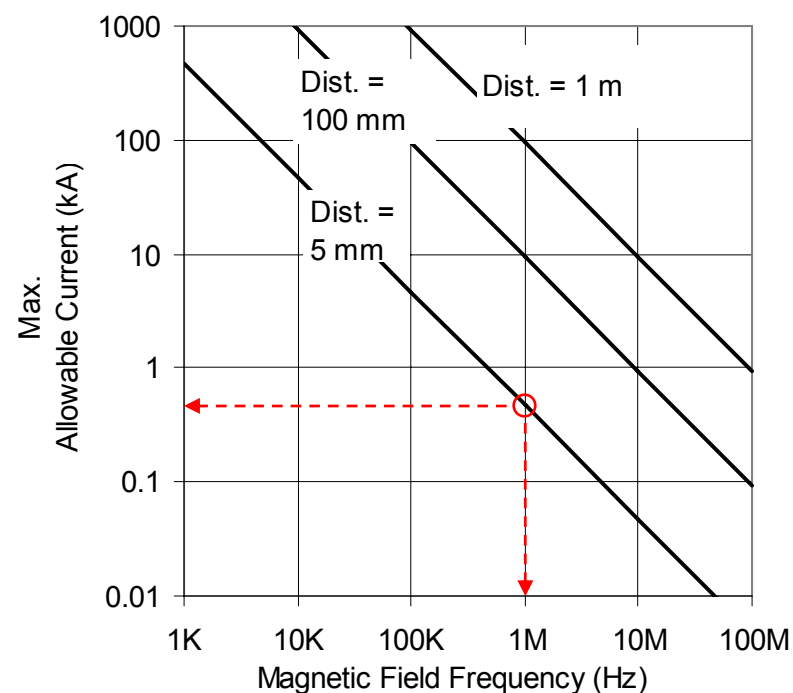
◆ Magnetic Isolator Standard for Reinforced Insulation (DIN EN 60747-5-5) Approved 4Q06 – Product Approval is Pending

*i*Coupler Products are Extremely Immune to External Magnetic Fields

Maximum Allowable Magnetic Field



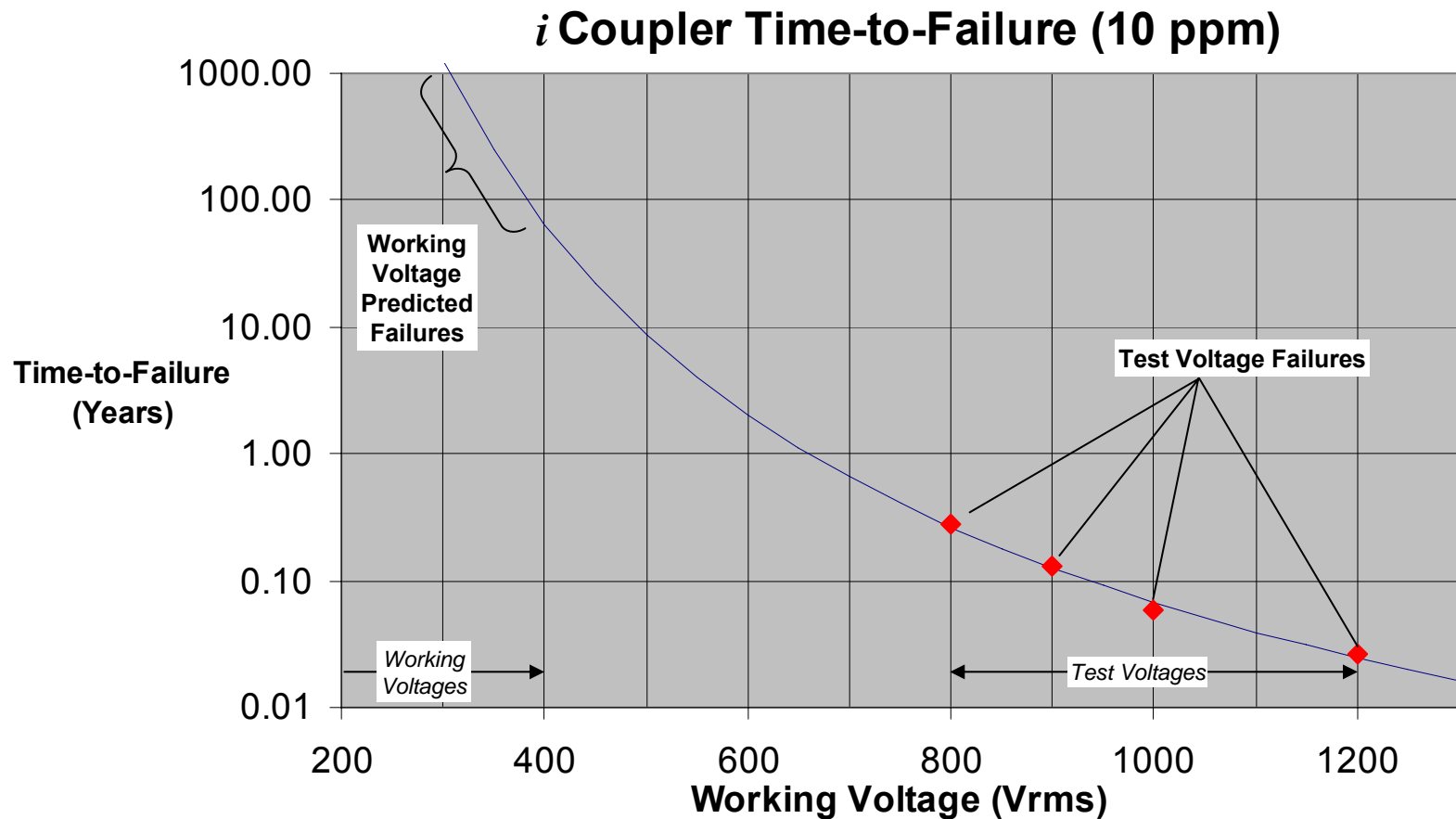
Maximum Allowable Current

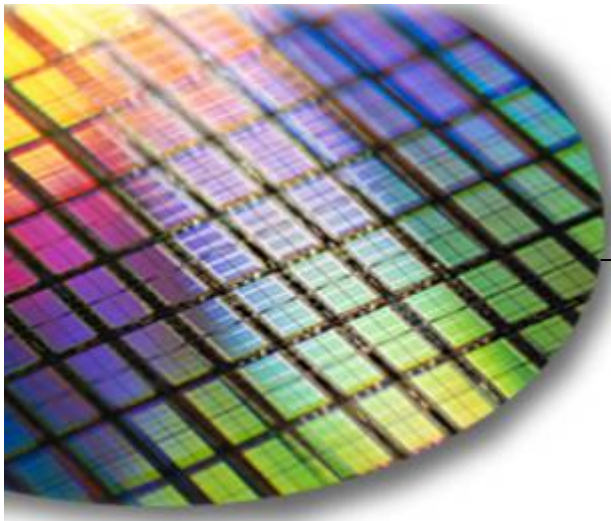


Example: A 1 MHz current placed 5 mm away from an *i*Coupler transformer must have an amplitude of 500A in order to cause an *i*Coupler disruption!

High Voltage Lifetime Evaluated via Accelerated Life Testing

Voltage (V_{RMS})	Predicted Lifetime at 10 ppm (Years)
200	>100,000
300	1300
400	65



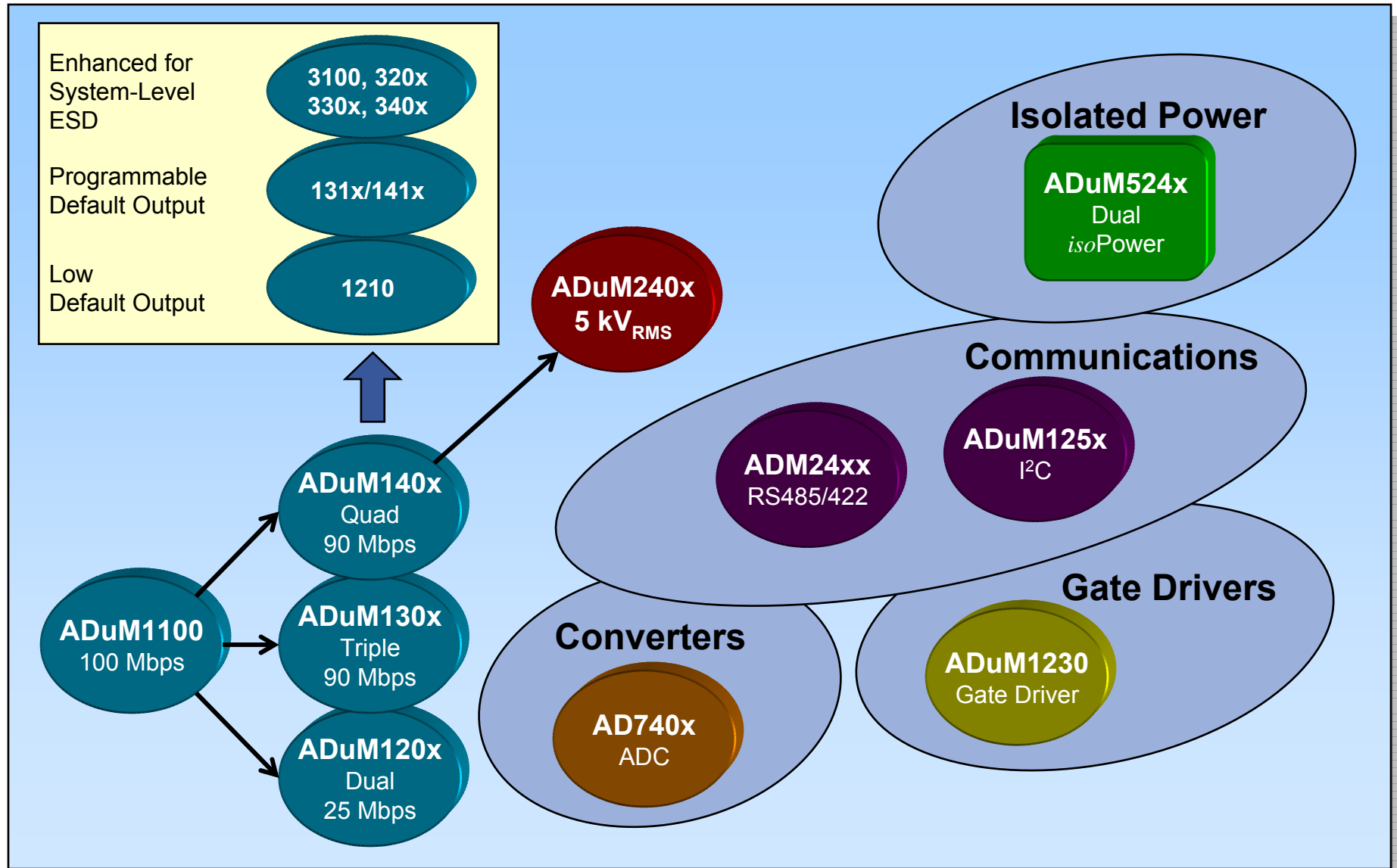


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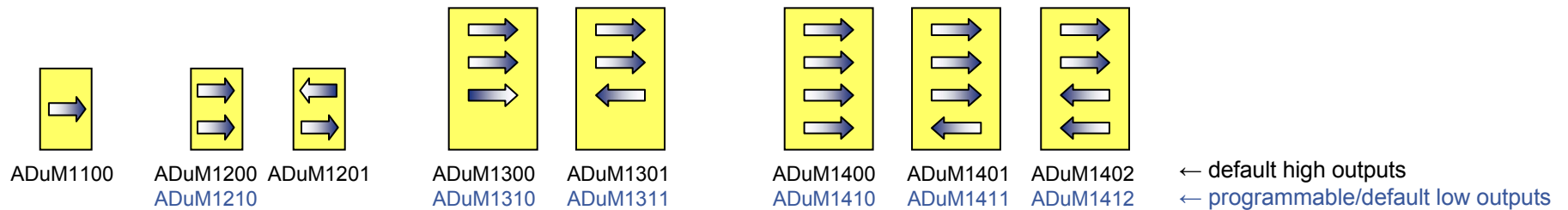
*i*Coupler Products

Advancing Beyond Standard Isolation



Standard Isolators

◆ Single/Dual/Triple/Quad Configurations



◆ Multiple Performance Grades

	Maximum Data Rate		
	Low Grade	Medium Grade	High Grade
ADuM1100		25	100
ADuM120x	1	10	25
ADuM1210	--	10	--
ADuM130x/ADuM140x	1	10	90
ADuM131x/141x	1	10	--

◆ Features

- 105°C Max. Operating Temperature
- 2.7-5.5V Voltage Level Translation
- 8- and 16-Lead SOIC Packages
- UL, CSA, VDE Approvals:
 - ◆ Max. Working Voltage: $400V_{RMS}$
 - ◆ Isolation Rating (1 minute): $2.5KV_{RMS}$



The Need for Improved System-Level ESD Hardness

- ◆ **Many Industrial Applications have Challenging System Test Requirements**
 - IEC-61000-4-2 (ESD) to 15kV Test Levels
 - IEC-61000-4-5 (Fast Transient/Burst)

- ◆ **Application Note – ESD Guidance and Recommendations**
 - Application Note AN-793 available at www.analog.com/icoupler
 - Recommended reference for use in all applications

- ◆ **ADuM3xxx “ESD-Hardened” iCouplers**
 - Recommended for the most challenging system-level requirements
 - Equivalent to ADuM1100, ADuM120x, ADuM130x, ADuM140x
 - Future products to employ best-in-class system-level ESD hardness



ADuM3xxx Products for System-Level ESD

◆ Improved ESD Robustness

- Critical Metal-Traces and Devices Enlarged
- Improved ESD-Protection at I/O's
- Supply Over-Voltage Protection Clamp

◆ Comparison to Existing *i*Couplers

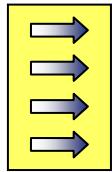
- | | |
|-------------------|-----------|
| ● Performance: | Identical |
| ● Package/Pinout: | Identical |
| ● Pricing: | +5% |

◆ Products

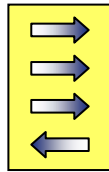
- ADuM3100 (Single-Channel)
- ADuM3200/3201 (Duals)
- ADuM3300/3301 (Triples)
- ADuM3400/3401/3402 (Quads)

5kV Isolators

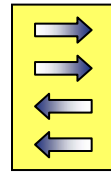
◆ Three Configurations Each With Three Performance Grades



ADuM2400



ADuM2401



ADuM2402

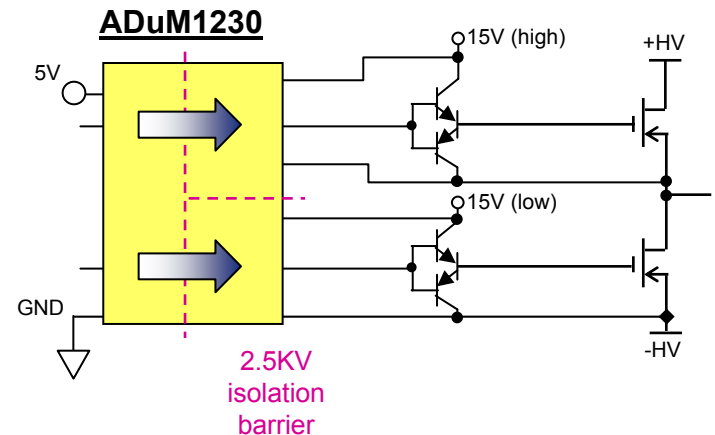
◆ Features

- 5kV Insulation Rating
- 2.7 – 5.5V, 105°C Operation
- 16-Lead Wide Body SOIC Package
- UL, CSA, VDE Approvals
- ➔ ● IEC 60601-1 Approval (Medical)



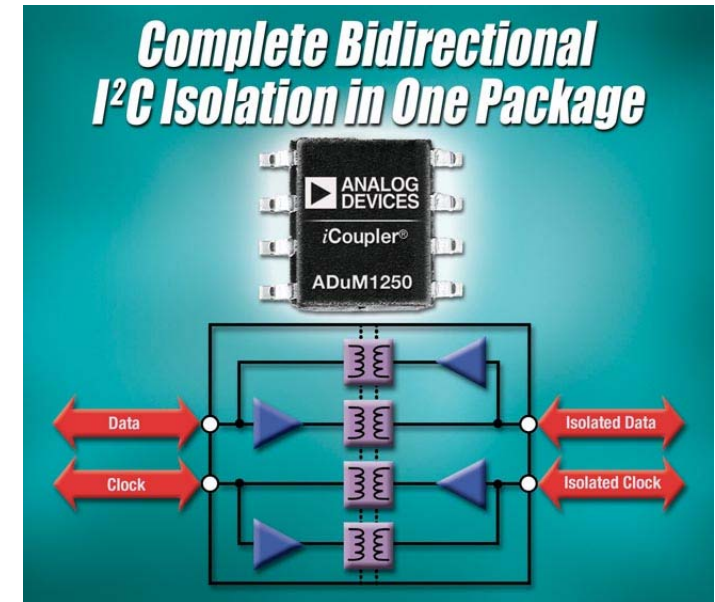
ADuM1230 Isolated Half-Bridge Driver

- ◆ **Isolated High and Low Outputs**
(outputs isolated from each other)
- ◆ **15V/0.1A Isolated Outputs**
- ◆ **>25 kV/μS Transient Immunity**
- ◆ **<10 ns Channel-to-Channel Matching**
- ◆ **16-Lead Wide Body Package**



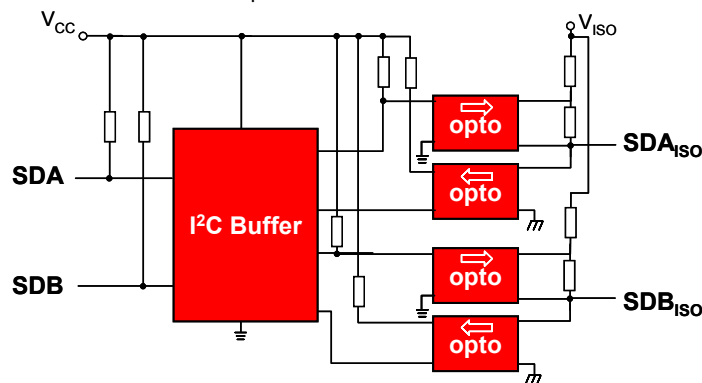
ADuM125x Isolates I²C in One Component

- ◆ Bi-Directional Data Transfer up to 1 Mbps
- ◆ Bus-Side Characteristics:
 - Sinks up to 30 mA
 - Drives Up to 400 pF Load
 - Hot-Swappable
- ◆ 2.5 kV_{RMS} Isolation Rating
- ◆ In Production



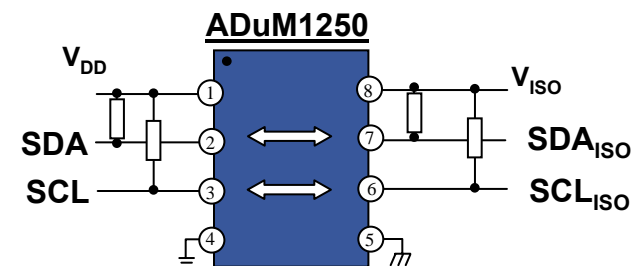
Optocoupler Solution

- Board area: 350 mm²
- Cost: \$3.10



iCoupler Solution

- Board area: 40 mm²
- Cost: \$2.50

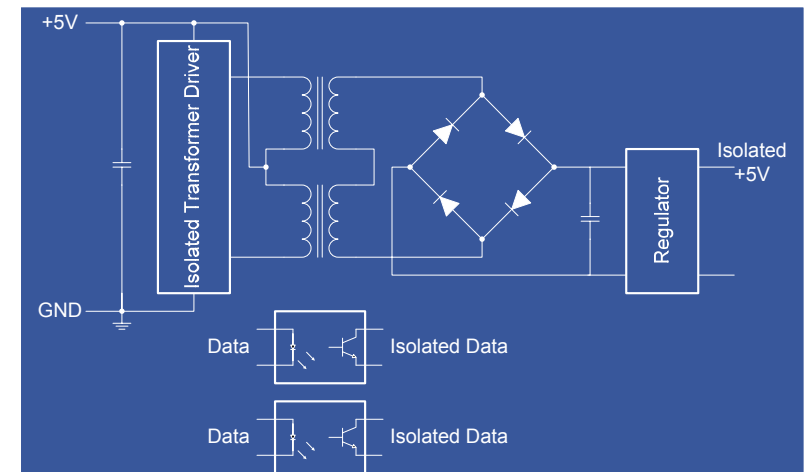


Common Problem: How to Isolate Power?

Two Discrete Options: Neither One Desirable

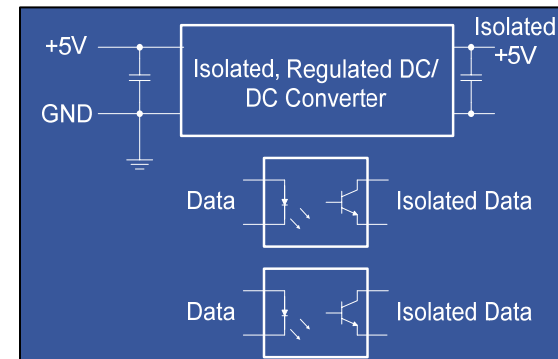
Optocoupler-plus-Custom Isolated Supply

- ◆ Large
- ◆ Requires design expertise
- ◆ Long development



Optocoupler-plus-Integrated Converter

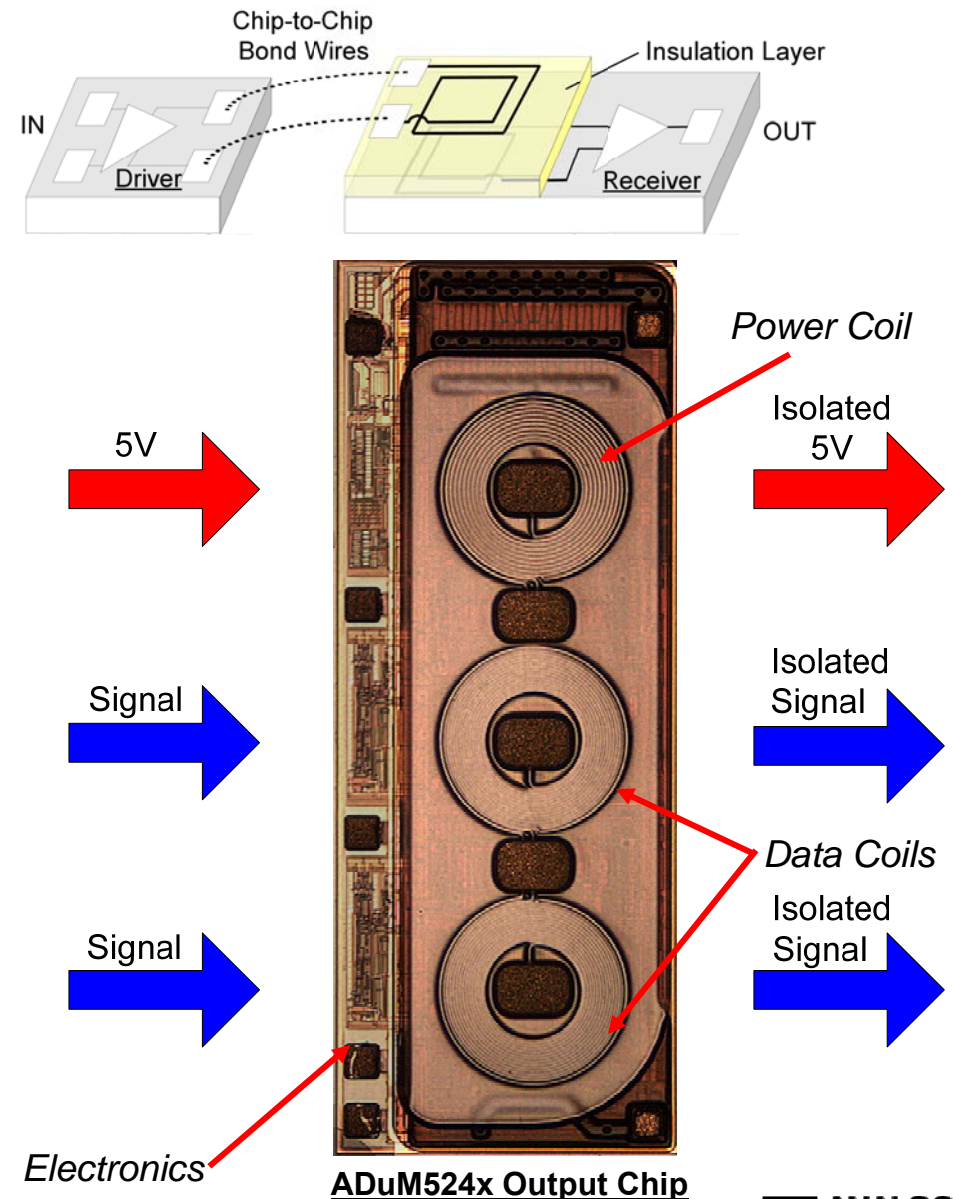
- ◆ Inadequate isolation rating (0.5 – 1.5 kV) for many applications
- ◆ Expensive



iCoupler Technology Extended to Address Data and Power

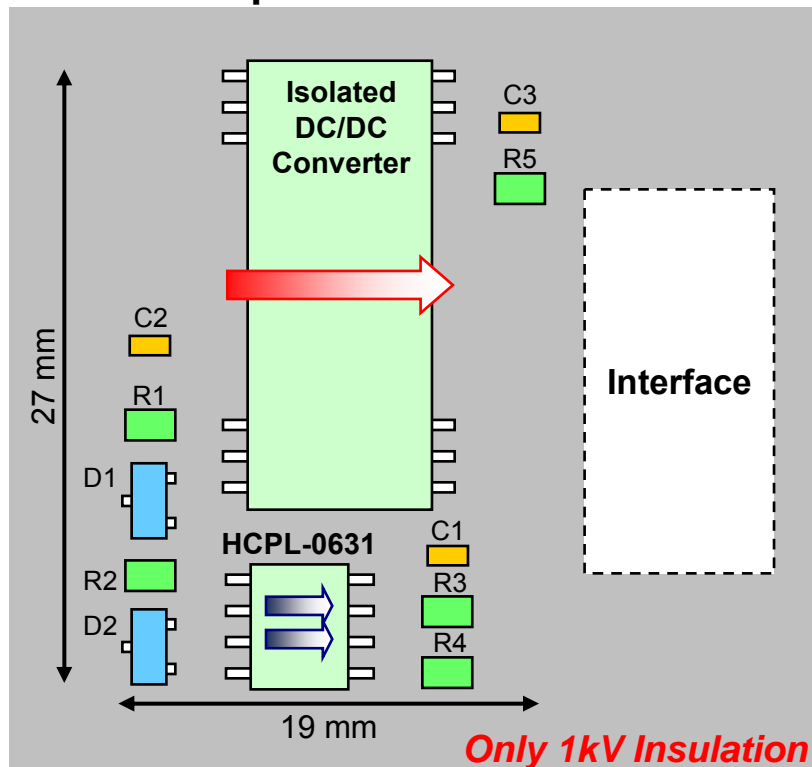
isoPower Overview

- ◆ **iCoupler micro-transformers are the basis for DC/DC conversion**
 - 20μm polyimide isolation withstands up to 5kV
 - 6μm thick gold coils
 - 800μm diameter coils
- ◆ **All DC/DC converter elements integrated within package**
 - Regulator
 - Switches
 - etc.



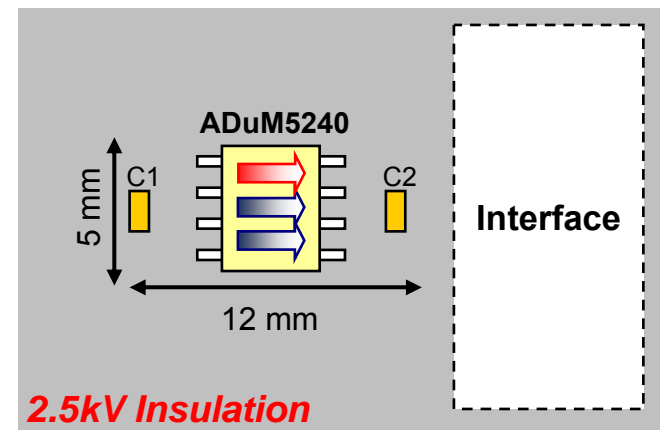
Breakthrough Option for Isolating Power 80% Smaller at Less Than Half the Price

Optocoupler Solution with Separate DC/DC Converter



Component Count:	12
Board Area:	510 mm ²
Estimated Cost*:	\$6.75

iCoupler Solution with *isoPower*

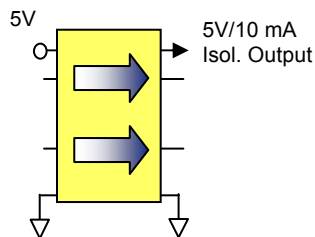


Component Count:	3
Board Area:	60 mm ²
Estimated Cost*:	\$2.15

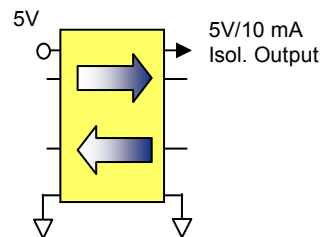
* 10K OEM pricing

ADuM524x: Dual Isolator with Integrated DC/DC Converter

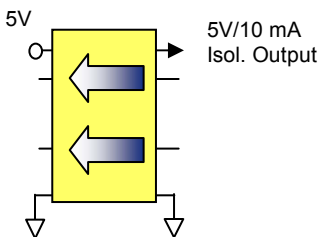
ADuM5240



ADuM5241



ADuM5242



- ◆ 8-Lead SOIC Package (5 x 6 x 1.6 mm)
- ◆ 50 mW Regulated, Isolated Output Power
 - 10mA @ 5V
- ◆ 2.5 kV_{RMS} Isolation Rating
- ◆ In Production

**Data And Power Isolation
In One Package**

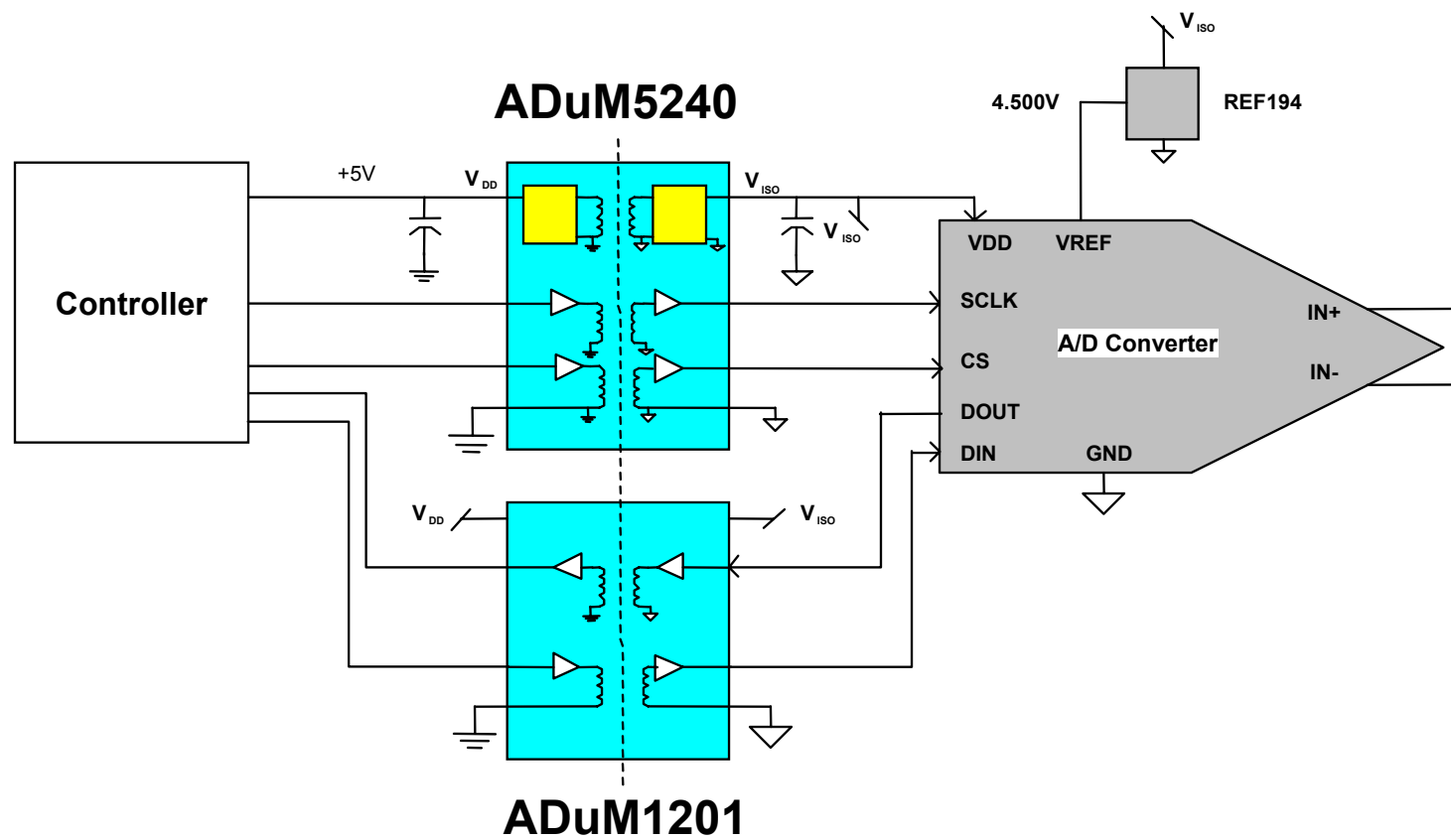
ADuM524x
ANALOG DEVICES

- *iCoupler*® technology in 8-lead SOIC package
- 80% smaller and 60% less expensive than optocoupler-plus-DC/DC solutions

Application Example: Data Acquisition

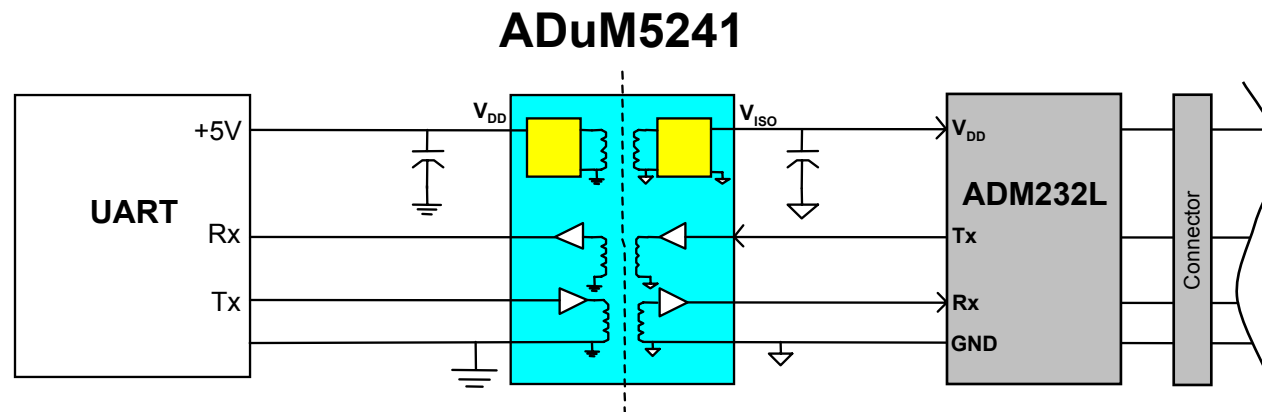
ADuM5240 with ADuM1201

- ◆ Board Space Reduced by ~70%
- ◆ Channel Cost Reduced by ~ 35%



Application Example: RS-232 Interface ADuM5241 with ADM232L for Basic Tx/Rx Communications

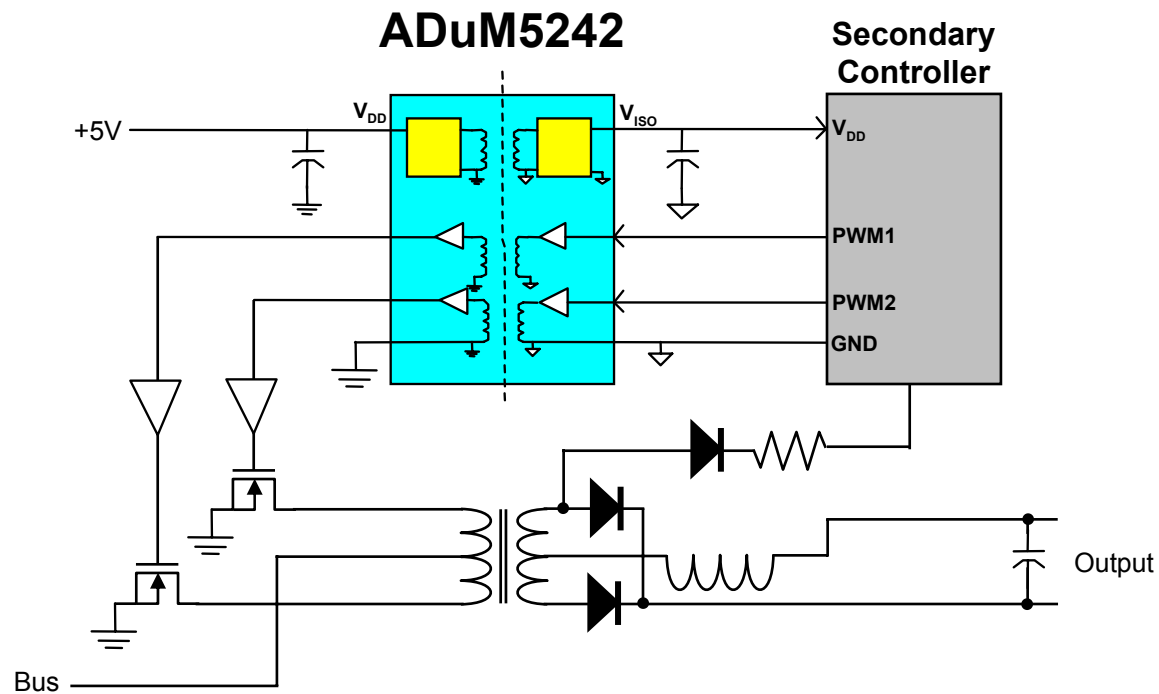
- ◆ Cost/size-effective implementation of isolated bus interface



Application Example: Power Supply

ADuM5242 Solves Secondary Controller Start-Up Problem

- ◆ Eliminates need for additional transformer windings and discretes



iCoupler Resources

◆ iCoupler Catalog

(www.analog.com/icoupler/brochure)

◆ Product Web Pages

- ADuM1100 – www.analog.com/ADuM1100
- ADuM120x – www.analog.com/ADuM120x
- ADuM130x – www.analog.com/ADuM130x
- ADuM140x – www.analog.com/ADuM140x
- ADuM131x – www.analog.com/ADuM131x
- ADuM141x – www.analog.com/ADuM141x
- ADuM125x – www.analog.com/ADuM125x
- ADuM524x – www.analog.com/ADuM524x

◆ Other Web Resources

- Frequently Asked Questions
- Regulatory Agency Reports
- Product Briefs
- Technical Articles
- Datasheets
- Evaluation Boards



The image shows the cover of the "iCoupler® Digital Isolation Products" brochure. At the top, there is a navigation bar with icons for Amplifiers, Power Management, Processors, DSP, MEMS, and Converters. The main title "iCoupler® Digital Isolation Products" is prominently displayed. Below the title is a photograph of an iCoupler chip on a circuit board. To the left of the photo is a "Table of Contents" listing sections like iCoupler Benefits, Quality and Reliability, Customer Testimonials, iCoupler Technology, Product Selection Table, and various ADuM series (ADuM1100, ADuM120x, ADuM130x, ADuM140x, ADuM131x, ADuM141x, ADuM125x, ADuM524x) with their respective page numbers. To the right of the photo is an "Introduction to Analog Devices' iCoupler Isolation Products" section, which discusses the challenges of signal isolation and how iCoupler technology provides a solution. At the bottom right, there is a diagram illustrating the isolation barrier between Port A and Port B, showing information flow and no current flow, with a list of benefits: Protect Human Equipment, Eliminate Grounding Problems, and Improve System Performance. The Analog Devices logo is at the bottom right.

iCoupler® Digital Isolation Products

Table of Contents

- iCoupler Benefits 2
- Quality and Reliability 4
- Customer Testimonials 5
- iCoupler Technology 6
- Product Selection Table 7
- ADuM1100 Single-Channel Isolators 8
- ADuM120x Dual-Channel Isolators 9
- ADuM130x/ADuM140x Triple-/Quad-Channel Isolators 10
- ADuM1240x 5 kV Quad-Channel Isolators 11
- Technical Support 12

Introduction to Analog Devices' iCoupler Isolation Products

In a wide variety of systems, designers are faced with the challenge of signaling data between two points while preventing the flow of electrical current. This is typically needed for safety or grounding considerations. The solution to this problem is to employ a galvanic isolation device. Such a device allows signals to travel between the two points but prevents the flow of electrical current.

Common isolation solutions use either optocoupler, transformer, or capacitor techniques. None of these approaches has kept up with the relentless drive to improve the cost, size, power, performance, and reliability characteristics of electrical systems. As a result, the isolation function has become a limiting factor in many designs in regards to these characteristics.

Analog Devices' iCoupler technology eliminates this bottleneck. Based on chip scale transformer technology, iCoupler products bring the isolation function into the fold with other semiconductor functions with improvements in all these areas. As a result, designers can implement isolation in their designs without the cost, size, power, performance, and reliability constraints found with traditional isolation solutions.

Diagram: A block diagram showing Port A connected to an Isolator, which is connected to Port B. A blue arrow labeled "INFORMATION FLOW" points from Port A to Port B. A black arrow labeled "ISOLATION BARRIER" points from the Isolator to Port B. A text box on the right lists benefits: "PROTECT HUMAN EQUIPMENT", "ELIMINATE GROUNDING PROBLEMS", and "IMPROVE SYSTEM PERFORMANCE".

ANALOG DEVICES