

MagIC

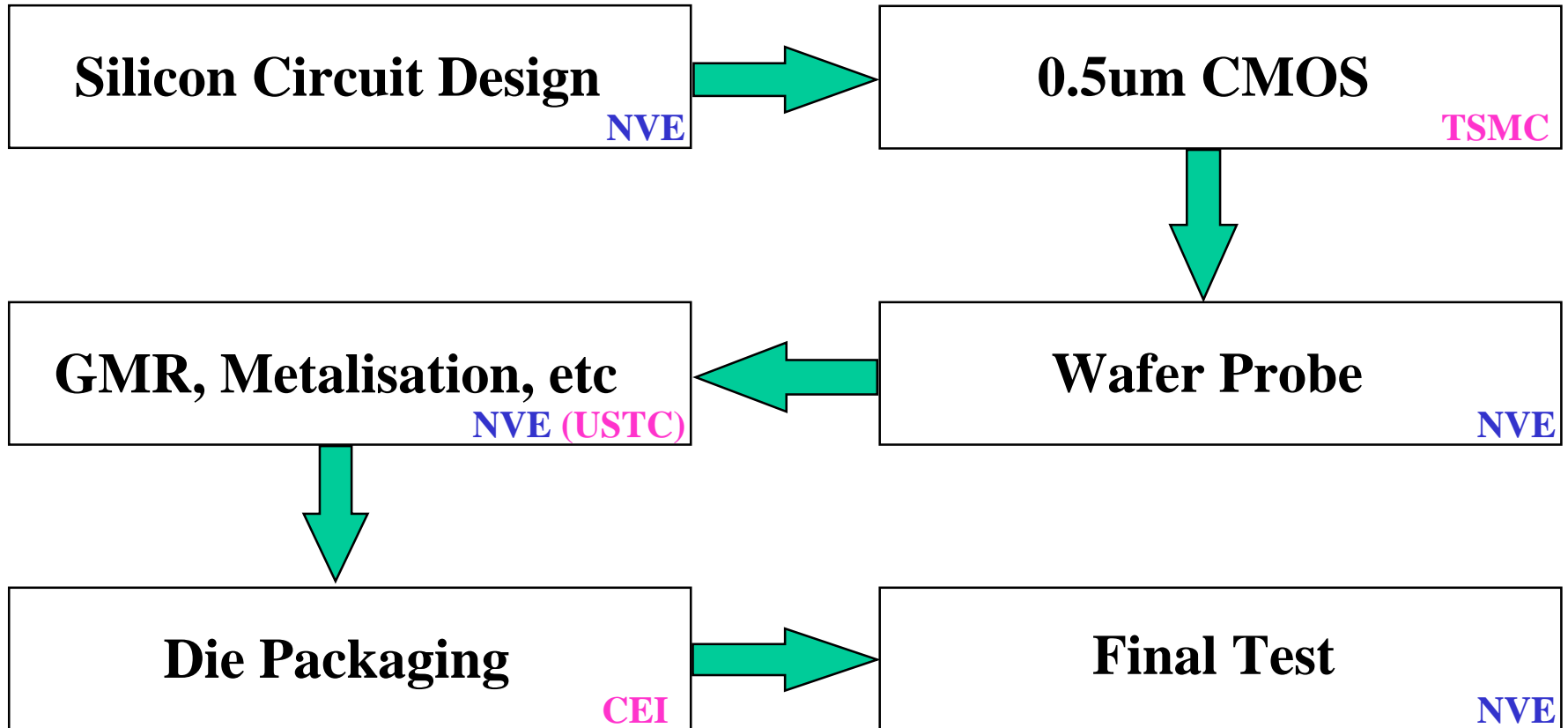
*Mag*netic And Silicon Materials
On One *I*ntegrated *C*ircuit

NVE is The World Leader In MagIC™

- **NVE Leads GMR Technology/Applications**
 - 11 years Experience (Since Founding in 1989)
 - Over \$30M Development
 - Competitive Government Contracts - \$20M
 - Commercial Customers - \$4.6M
 - Private Investment - \$4.5M
 - 32 Patents Issued, Pending, Or Licensed
- **World's First GMR Products (1995)**
- **World's First GMR MagIC™ Product (1997)**
- ISO 9001 qualified

- **Sensors - NVE Established Products**
 - 20,000 units per month (1999)
 - Wheel Speed and Position (Platform qualified for ABS)
 - Electric Current
- **Isolators - NVE New Products**
 - Communications
 - Industrial Controls
- **Nonvolatile Memory - NVE Next Generation**
 - Data Security without Power
 - Magnetoresistive Random Access Memory (MRAM)

Isolator: Design to Test

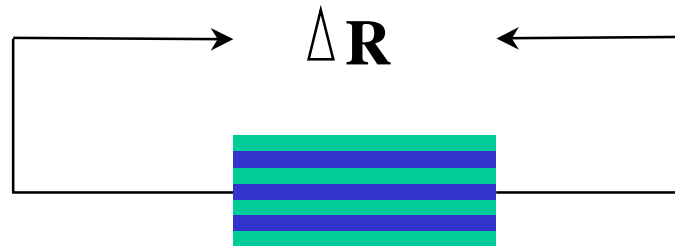


GMR

~ 8×10^{-9} m

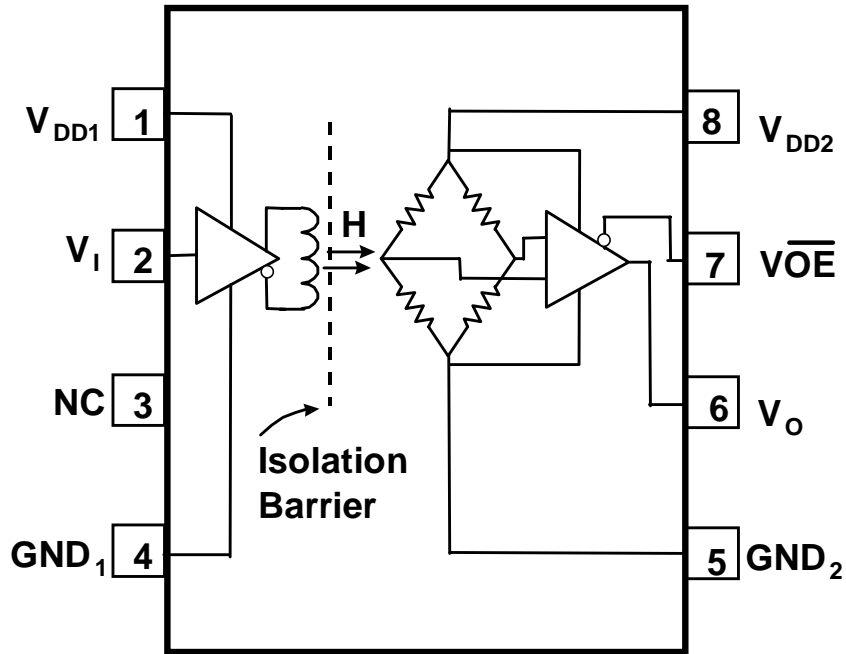


**Metallic Thin Films:
Magnetic / Non-Magnetic**



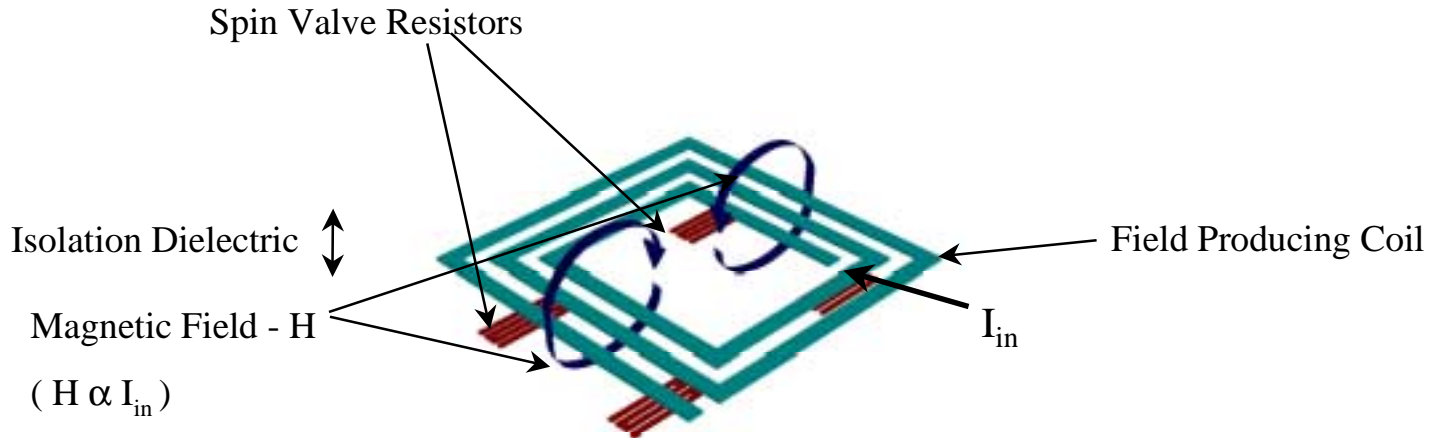
IL710

HIGH SPEED DIGITAL ISOLATOR

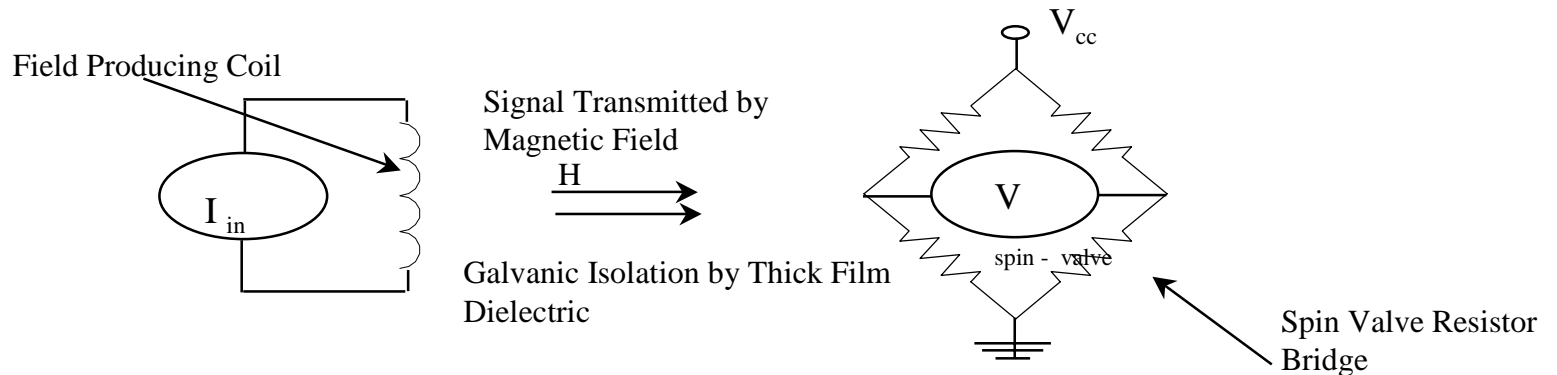


| TRUTH TABLE | | |
|-------------|-----------------|-------|
| V_{IN} | \overline{OE} | V_O |
| L | L | L |
| H | L | H |
| L | H | Z |
| H | H | Z |

Memory Mode Digital Spin Valve Isolator Structure



Memory Mode Digital Spin Valve Isolator Schematic



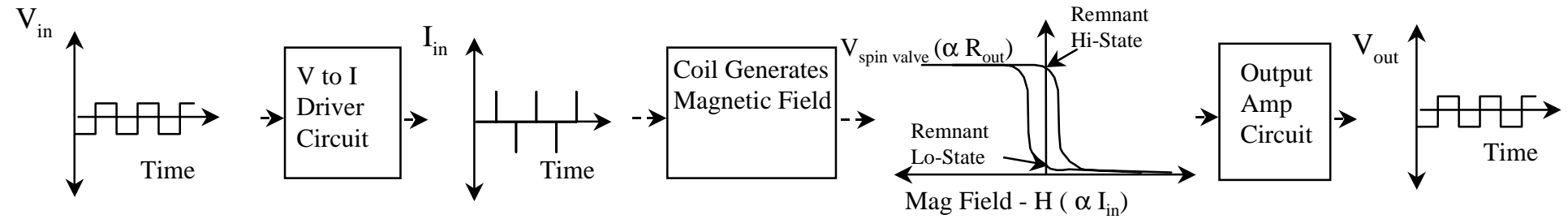
GMR Isolator Transfer Function

Input Voltage Signal

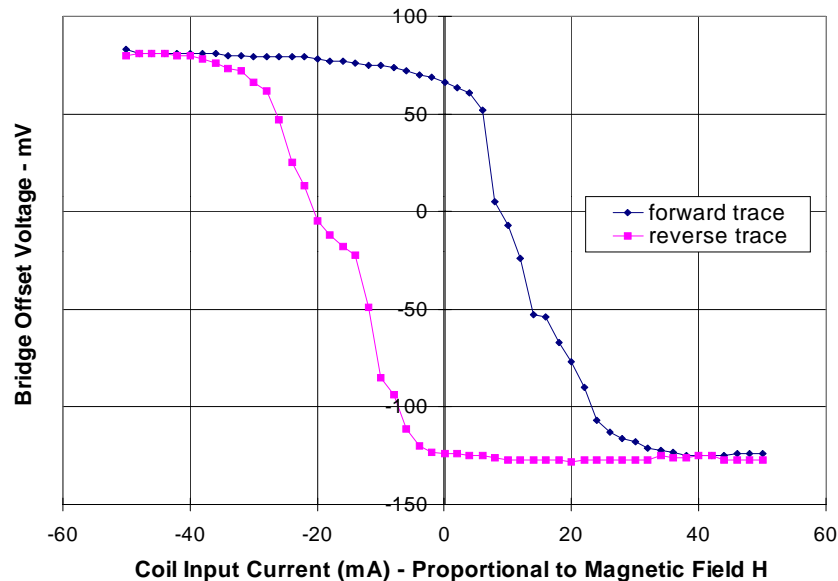
Coil Current Signal

Spin Valve Response

Isolated Output Voltage

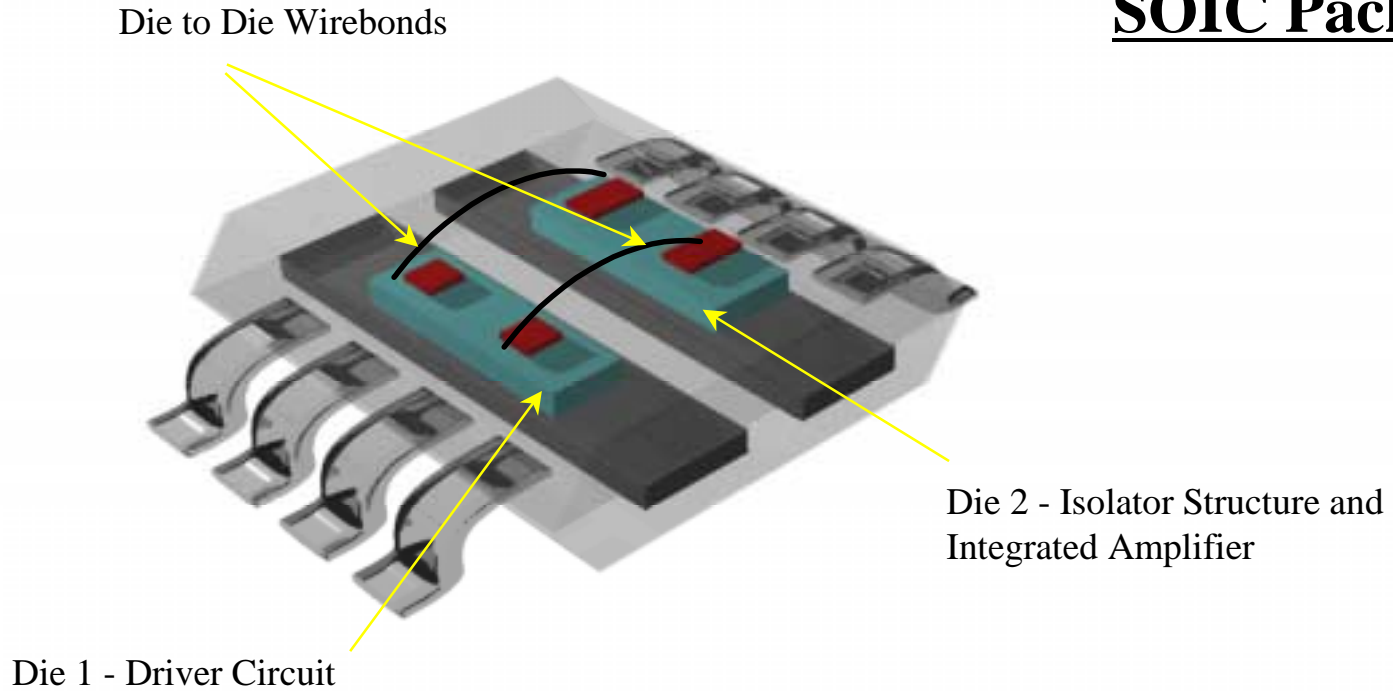


Schematic of Memory Mode Spin Valve Digital Signal Isolator

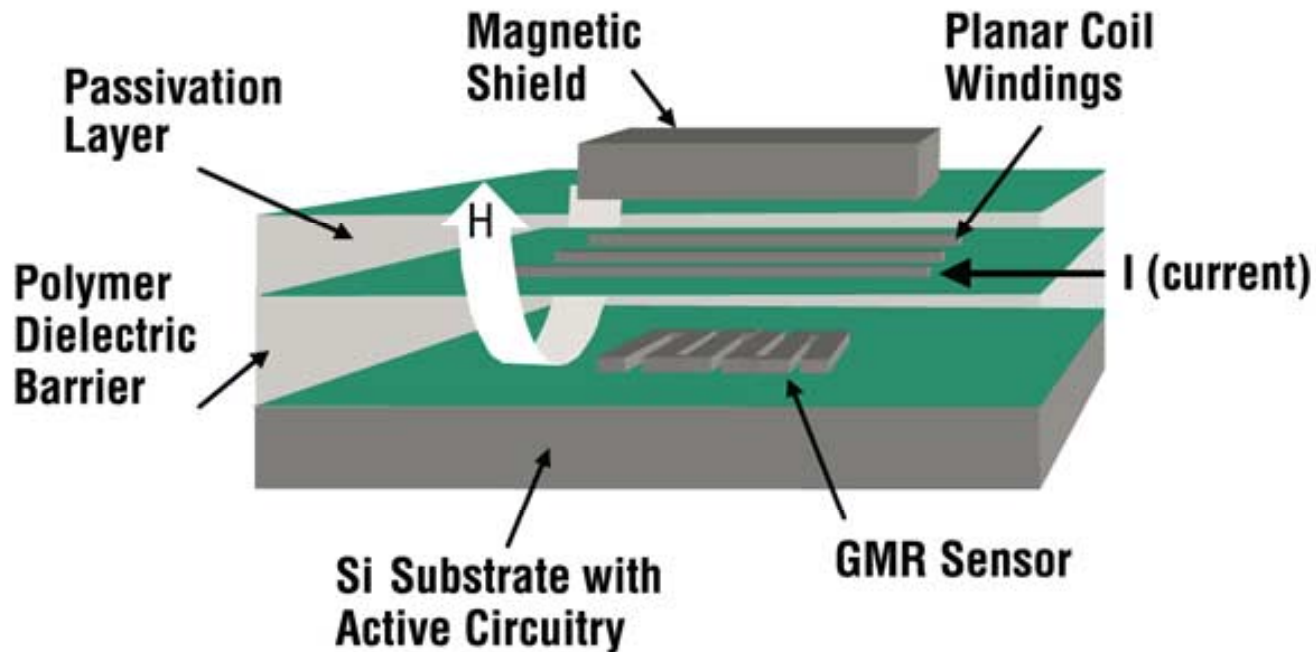


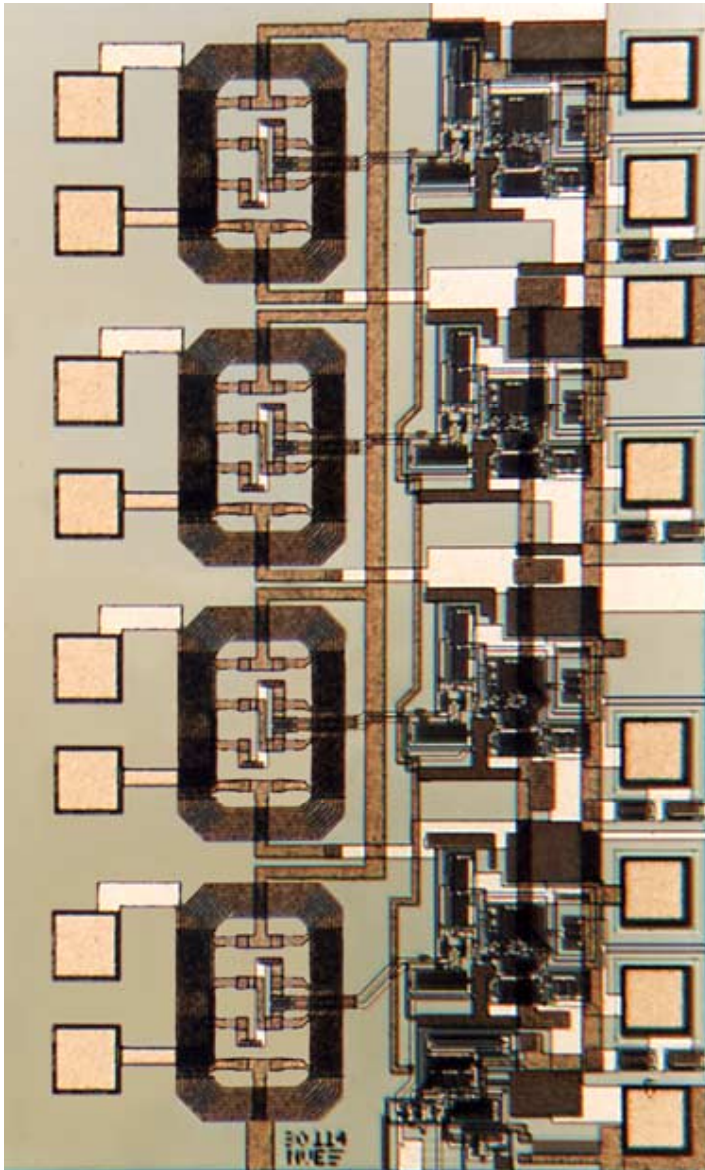
Magnetoresponse of Actual Patterned Spin Valve Isolator Structure

SOIC Package



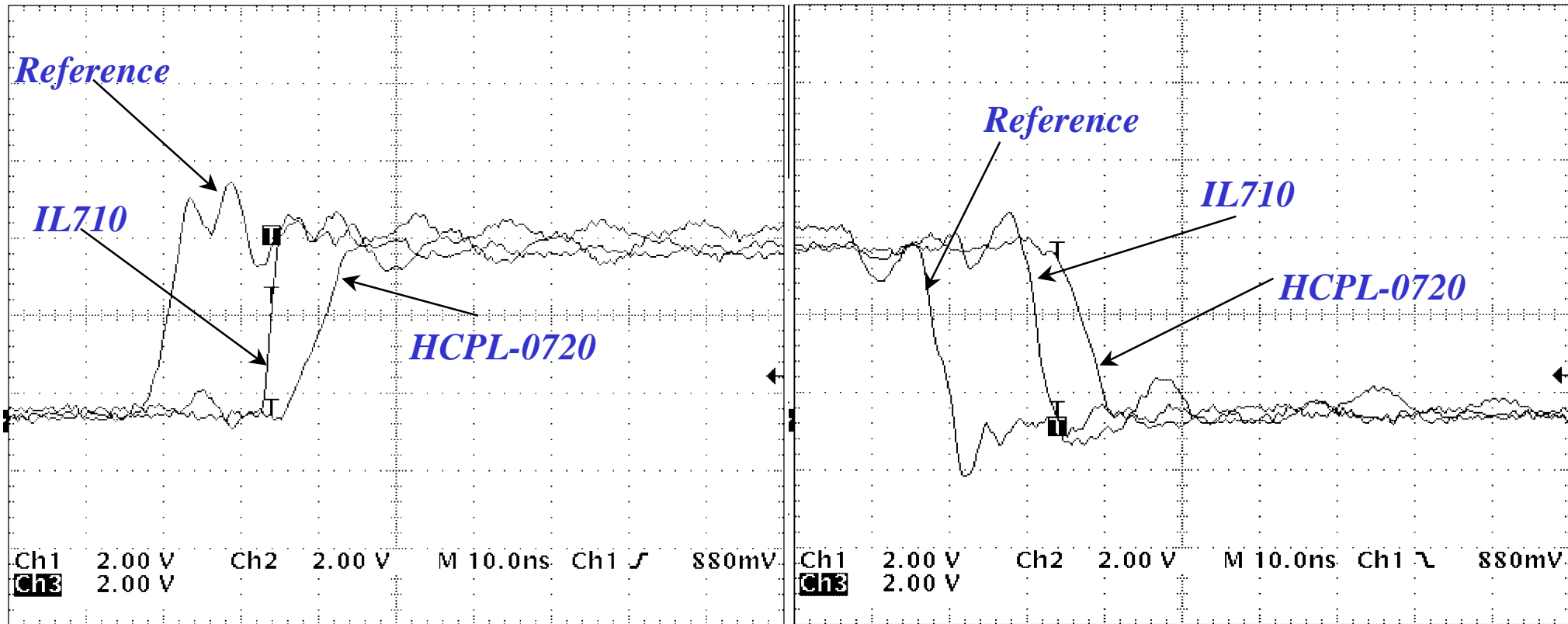
Magnetic Isolator - Schematic



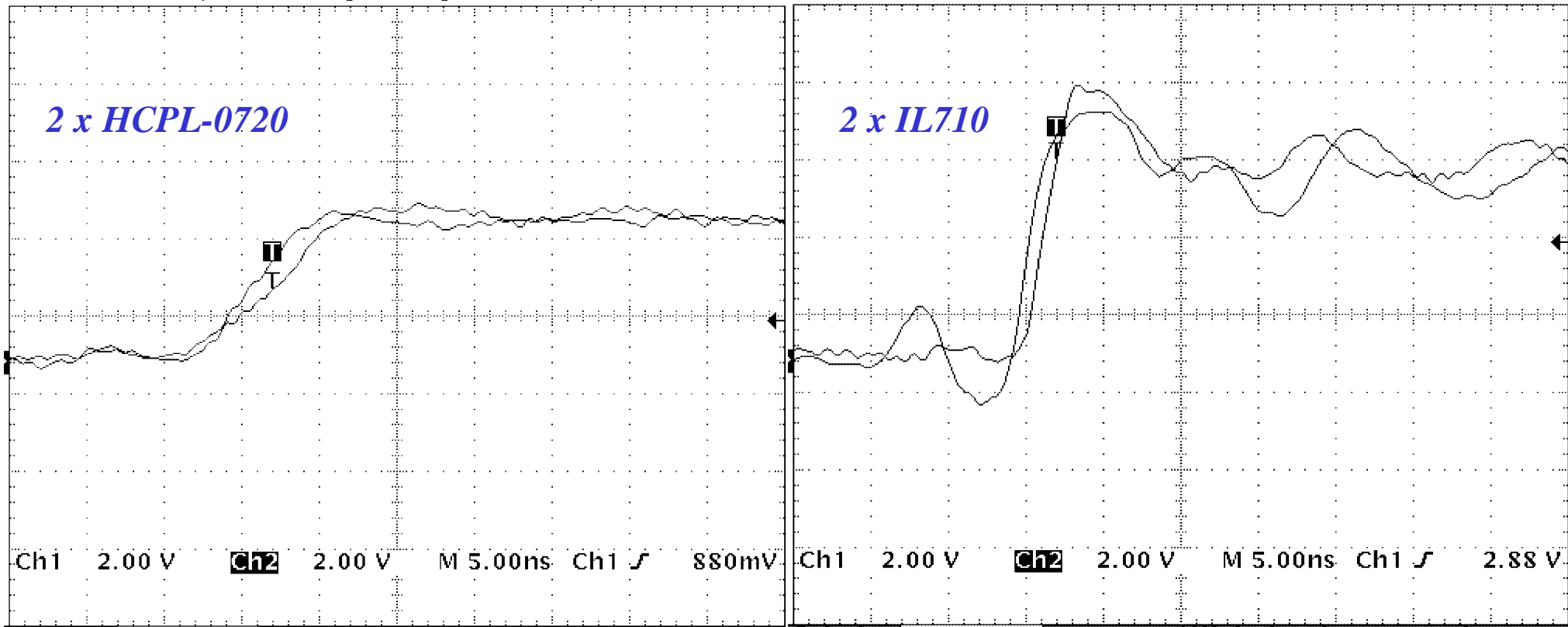


Die Photograph
4-channel Isolator
Size: 1.1mm x 1.9mm

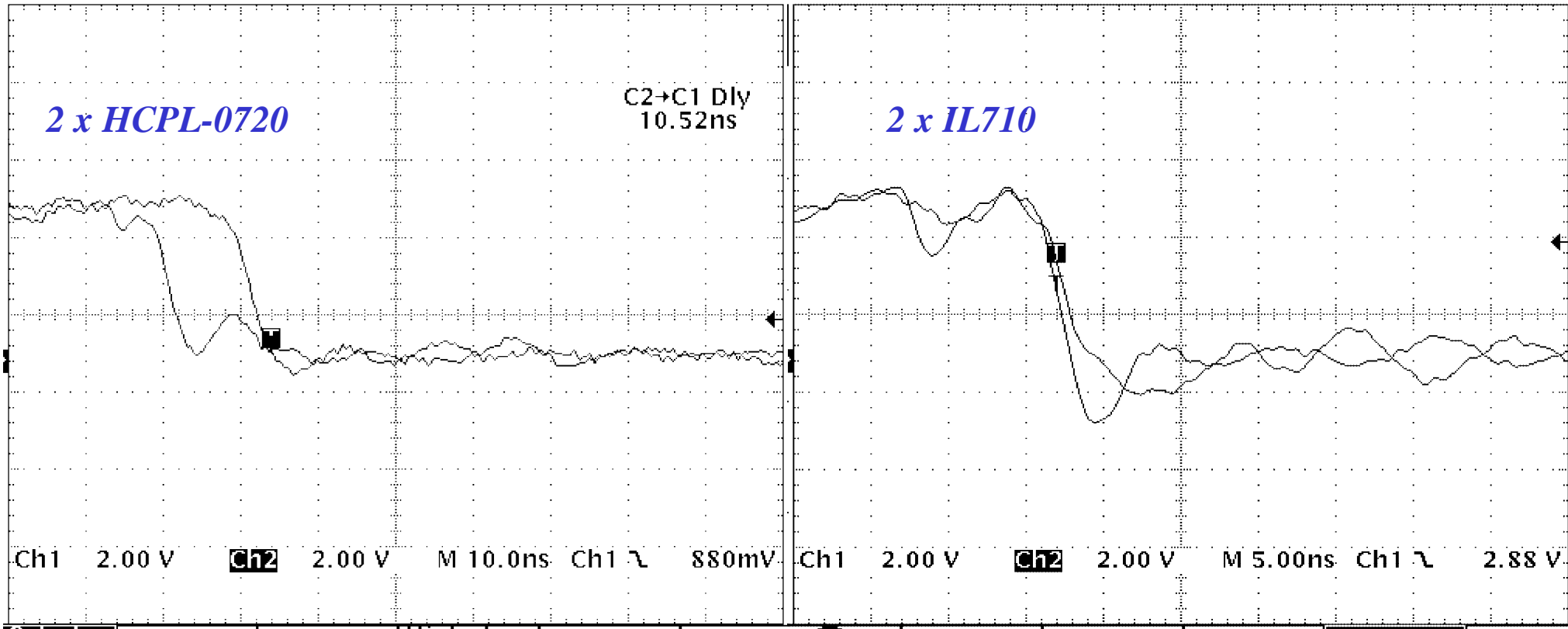
Propagation Delay



Positive Edge Skew



Negative Edge Skew



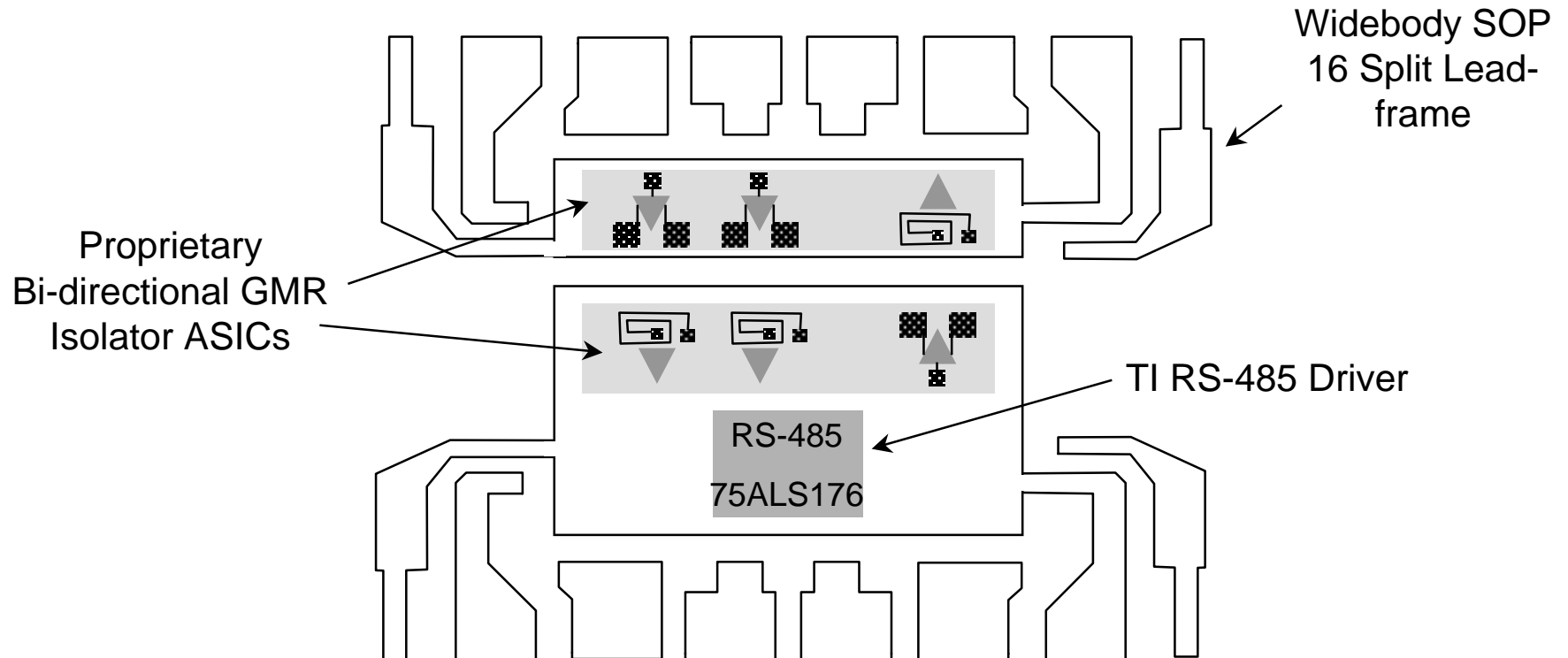
No More *Speed* Problems



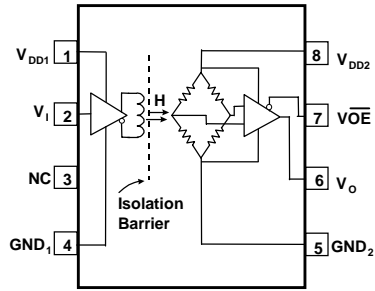
- *4 x Speed*
- *2 x Transient Immunity*
- *1/4 PWD*
- *1/4 Prop Delay*
- *1/5 Skew*

GMR Isolated RS 485 Module

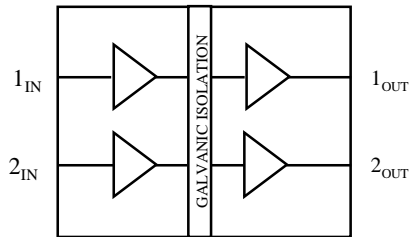
- 16 Pin SOP Wide Body Package
- Proprietary Bi-directional GMR Isolator ASIC
- TI 75ALS176 RS-485 Transceiver



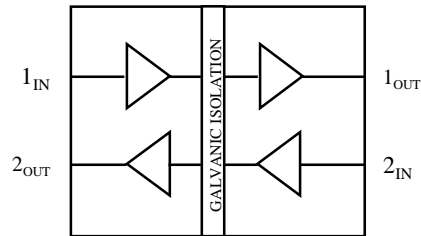
First New Products



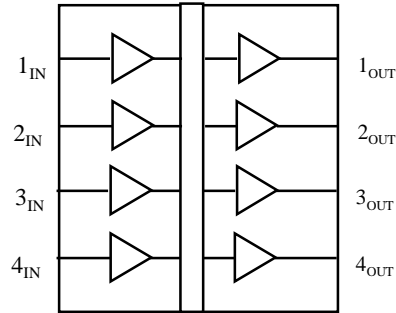
IL710



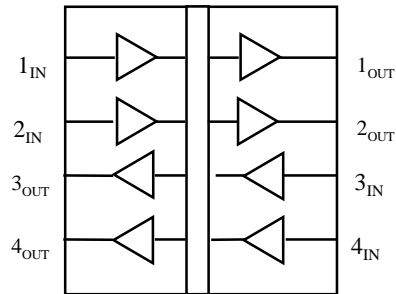
IL711



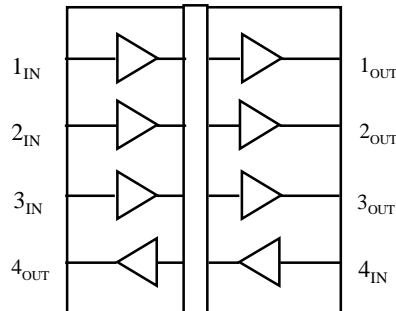
IL712



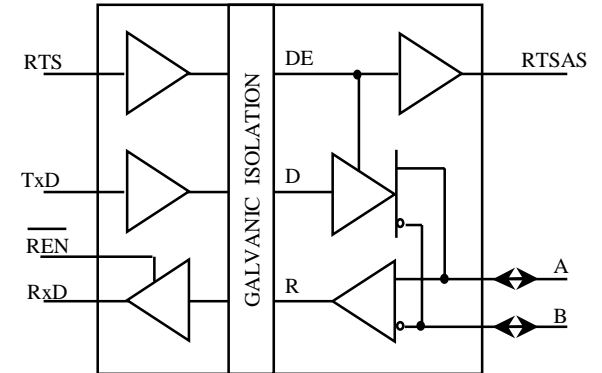
IL715



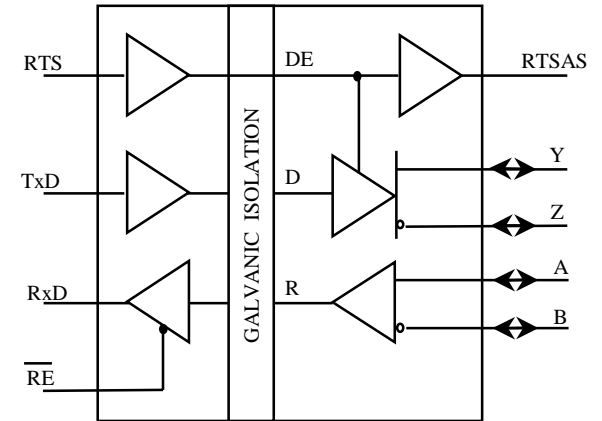
IL716



IL717



IL485

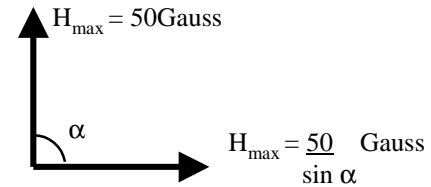
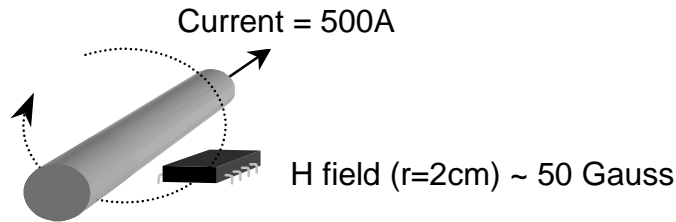


IL422

External Magnetic Field Sensitivity

- Tolerant to 50 Gauss normal to plane of device
- Design improvements have increased it to ~ 100 Gauss
- Field produced by current is not be a problem
- Equation is as follow:

$$H \approx \frac{I \sin \alpha}{2\pi R * 0.8} \quad (\text{Where } I \text{ is amps, } R \text{ is cm \& } H \text{ is Gauss})$$



- Current Draw (amps)

500
10

- Safe Separation Distance

2.0 cm.
0.4 mm