ITT OVERVIEW
A Multi-Industry Market Leader

ITT Industries
Steve R. Loranger, President and Chief Executive Officer

2002 Sales $4,999

Fluid Technology
Largest pump manufacturer worldwide

2002 Sales $1,960

Defense Electronics & Services
A leader in high technology electronic systems and services

2002 Sales $1,510

Electronic Components
A leading supplier of connectivity and interface solutions

2002 Sales $584

Motion & Flow Control
Leading supplier of shock absorbers, and brake materials

2002 Sales $936
Serving diverse markets and regions

### End Markets
- Commercial Aircraft: 6%
- Communications: 32%
- Industrial: 23%
- Transportation: 13%
- Military: 13%
- Other: 13%

### Regions
- North America: 40%
- Europe: 35%
- Asia-Pacific: 25%
Strong global manufacturing and R&D presence

- Headquarters: Santa Ana, California
- Worldwide Employees: 10,500
- Manufacturing Space: 2.5 Million Square Feet
Our Strategies: Operational Excellence

The Overarching Strategy for all Continuous Improvement

Premier Multi-Industry Performance

Superior Customer Satisfaction

Leadership

Value-Based Product Development

Value Based Management

Lean Production

Six Sigma Problem Solving
MOTOR CONNECTOR WITH INTEGRAL CAPACITOR

Drop in replacement for existing connector block. Over-moulded connector with integral grounding clip, contacts and capacitor.

Grounding clip provides grounding on all sides to create a good ground plane and reduce impact on capacitor performance.

Connector bites into the motor body casing on assembly to provide good contact resistance performance.

Patents Pending
MOTOR CONNECTOR WITH INTEGRAL CAPACITOR

Patents Pending

The capacitor is located inside a pocket of the overmould where it is protected from damage. Capacitor contacts are arranged inside the pocket to accept the capacitor. The capacitor is reflow soldered into position after assembly.

Contact arrangement and connector design is identical on the outside of the motor.

Cannon

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Concern over differential expansion

Differential expansion of the capacitor vs. the surrounding contacts, plastic and ground plate may cause fretting of the solder joints, resulting in failure.

Solutions

1. Flexible silver loaded polymer pads on the capacitor
2. Compliant springs soldered to the capacitor
3. Capacitor press fitted into a sprung socket
4. Combination of the above
Confidence testing

Solder device

- Silver plated brass posts
- PTFE insulators
- X2Y® capacitor soldered into carrier
- Silver plated brass ground block

Compliant device

- Plastic carrier with 4 silver plated spring clips installed
- X2Y® Capacitor loaded into carrier
- Chip carrier loaded into test connector
MOTOR CONNECTOR WITH INTEGRAL CAPACITOR

Photographs of connectors embedded in motors

Soldered device

Compliant device

Patents Pending
BASELINE RESULTS

Comparison of original filtered and unfiltered motor.

Measurements made using a current probe around DC feed cable, and a spectrum analyser to detect variation in noise levels.
MOTOR CONNECTOR WITH INTEGRAL CAPACITOR

SOLDERED X2Y® CHIP vs BASELINE RESULTS

Graph showing dBuV vs FREQUENCY (MHz) for STANDARD and Soldered X2Y 400nF CW
MOTOR CONNECTOR WITH INTEGRAL CAPACITOR

COMPLIANT X2Y® CHIP vs SOLDERED X2Y® CHIP vs BASELINE RESULTS

Compliant device shows slight increases in noise at certain frequencies.
RETEST OF COMPLIANT X2Y® CHIP USING ADDITIONAL GROUNDING TAPE AROUND MOTOR CASE.

Improvement in noise levels when copper tape is used to improve grounding.
MOTOR CONNECTOR WITH INTEGRAL CAPACITOR

GRAPH SHOWING TEST RESULTS TO 1GHz

FREQUENCY (MHz)

dBuV

Unfiltered  soldered X2Y 400nF  soldered X2Y 400nF Neg grounded  soldered X2Y 400nF CW  carrier X2Y 400nF CW

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Engineered for life
CISPR 25 Test Results

• Using chip carrier device
• Radiated emission results
• Conducted emission results
• Running under ‘no load’ condition
• Tests conducted by Radio Frequency Investigation
MOTOR CONNECTOR WITH INTEGRAL CAPACITOR

Compliant device w/ X2Y®, conducted emissions

<table>
<thead>
<tr>
<th>Class</th>
<th>0.15MHz to 0.3MHz</th>
<th>0.53MHz to 2.0MHz</th>
<th>5.9MHz to 6.2MHz</th>
<th>30MHz to 54MHz</th>
<th>68MHz to 108MHz</th>
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<td>100</td>
<td>82</td>
<td>64</td>
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Broadband Conducted emissions as per table 6 of CISPR 25
This part passes at level 5 from 0.53MHz up to 108MHz
Compliant device w/ X2Y®, radiated emissions

<table>
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<tr>
<th>Class</th>
<th>Levels in dB(µV)</th>
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<td>0.15MHz to 0.3MHz</td>
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<td>83</td>
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Broadband Radiated emissions as per Table 10 of CISPR 25
Worst case values taken from both horizontal and vertical measurements
CISPR 25 Test Results summary

The compliant device w/ X2Y®, passed at level 5 except at the 0.15MHz to 0.30MHz frequencies on conducted emissions.
MOTOR CONNECTOR WITH INTEGRAL CAPACITOR

Connector design proposal for next step
Ground plate

Progression stamped from steel strip, tin/silver plated

Tabs lock onto either side of motor casing for good grounding
MOTOR CONNECTOR WITH INTEGRAL CAPACITOR

Patents Pending

Over moulding process

Exposed ground plates in cavity for chip

Retention features for cover moulding as required

Progression over moulded on strip
MOTOR CONNECTOR WITH INTEGRAL CAPACITOR

Patents Pending

Contact (x 2)

Progression stamped from copper alloy strip, tin/silver plated

Retention barbs lock into plastic
Contact assembly

Contacts stitched in from this side

Chip connects to side of contact
MOTOR CONNECTOR WITH INTEGRAL CAPACITOR

Patents Pending

Optional $-V_e$ earth grounding

Clearance between contact and ground plate

Smaller slot in ground plate cause contact barbs to press fit into ground plate

Ungrounded

Grounded
MOTOR CONNECTOR WITH INTEGRAL CAPACITOR

**Patents Pending**

Chip carrier

X2Y® Chip
MOTOR CONNECTOR WITH INTEGRAL CAPACITOR

Patents Pending

CONTACT LOCKING TABS

CHIP LOCATING RIBS

CONTACT STYLE 1

CONTACT STYLE 2

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Chip carrier assembly

X2Y® Chip carrier loaded into cavity. Compliant contacts mate with ground and power contacts.
MOTOR CONNECTOR WITH INTEGRAL CAPACITOR

Patents Pending

Assembly into motor housing
Thank You

For more information please contact us:

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