

4N38M, H11D1M, H11D2M, H11D3M, MOC8204M High Voltage Phototransistor Optocouplers

Features

- High voltage:
 - MOC8204M, $BV_{CER} = 400V$
 - H11D1M, H11D2M, $BV_{CER} = 300V$
 - H11D3M, $BV_{CER} = 200V$
- High isolation voltage:
 - 7500 V_{AC} peak, 1 second
- Underwriters Laboratory (UL) recognized
File # E90700, Volume 2
- IEC 60747-5-2 approved (ordering option V)

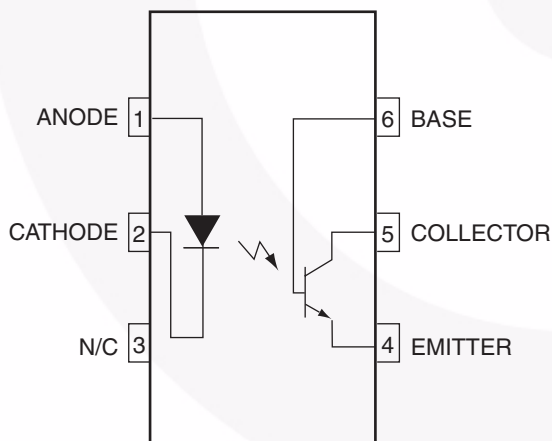
Applications

- Power supply regulators
- Digital logic inputs
- Microprocessor inputs
- Appliance sensor systems
- Industrial controls

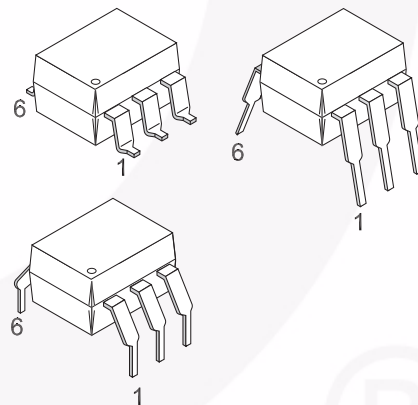
General Description

The 4N38M, H11DXM and MOC8204M are phototransistor-type optically coupled optoisolators. A gallium arsenide infrared emitting diode is coupled with a high voltage NPN silicon phototransistor. The device is supplied in a standard plastic six-pin dual-in-line package.

Schematic



Package Outlines



Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

| Symbol | Parameter | Device | Value | Units |
|---------------------|---|--|----------------|-------|
| TOTAL DEVICE | | | | |
| T _{STG} | Storage Temperature | All | -40 to +150 | °C |
| T _{OPR} | Operating Temperature | All | -40 to +100 | °C |
| T _{SOL} | Lead Solder Temperature (Wave Solder) | All | 260 for 10 sec | °C |
| P _D | Total Device Power Dissipation @ T _A = 25°C Derate Above 25°C | All | 260 | mW |
| | | | 3.5 | mW/°C |
| EMITTER | | | | |
| I _F | Forward DC Current ⁽¹⁾ | All | 80 | mA |
| V _R | Reverse Input Voltage ⁽¹⁾ | All | 6.0 | V |
| I _{F(pk)} | Forward Current – Peak (1µs pulse, 300pps) ⁽¹⁾ | All | 3.0 | A |
| P _D | LED Power Dissipation @ T _A = 25°C ⁽¹⁾ Derate Above 25°C | All | 150 | mW |
| | | | 1.41 | mW/°C |
| DETECTOR | | | | |
| P _D | Power Dissipation @ T _A = 25°C Derate linearly above 25°C | All | 300 | mW |
| | | | 4.0 | mW/°C |
| V _{CER} | Collector to Emitter Voltage ⁽¹⁾ | MOC8204M | 400 | V |
| | | H11D1M, H11D2M | 300 | |
| | | H11D3M | 200 | |
| | | 4N38M | 80 | |
| V _{CBO} | Collector Base Voltage ⁽¹⁾ | MOC8204M | 400 | V |
| | | H11D1M, H11D2M | 300 | |
| | | H11D3M | 200 | |
| | | 4N38M | 80 | |
| V _{ECO} | Emitter to Collector Voltage ⁽¹⁾ | H11D1M, H11D2M, H11D3M, MOC8204M | 7 | V |
| I _C | Collector Current (Continuous) | All | 100 | mA |

Note:

- Parameters meet or exceed JEDEC registered data (for 4N38M only).

Electrical Characteristics (T_A = 25°C unless otherwise specified.)

Individual Component Characteristics

| Symbol | Characteristic | Test Conditions | Device | Min. | Typ.* | Max. | Unit |
|---------------------------------|---|--|-----------|------|-------|------|-------|
| EMITTER | | | | | | | |
| V _F | Forward Voltage ⁽²⁾ | I _F = 10mA | All | | 1.15 | 1.5 | V |
| $\frac{\Delta V_F}{\Delta T_A}$ | Forward Voltage Temp. Coefficient | | All | | -1.8 | | mV/°C |
| BV _R | Reverse Breakdown Voltage | I _R = 10μA | All | 6 | 25 | | V |
| C _J | Junction Capacitance | V _F = 0V, f = 1MHz | All | | 50 | | pF |
| | | V _F = 1V, f = 1MHz | | | 65 | | pF |
| I _R | Reverse Leakage Current ⁽²⁾ | V _R = 6V | All | | 0.05 | 10 | μA |
| DETECTOR | | | | | | | |
| BV _{CER} | Breakdown Voltage Collector to Emitter ⁽²⁾ | R _{BE} = 1MΩ, I _C = 1.0mA, I _F = 0 | MOC8204M | 400 | | | V |
| | | | H11D1M/2M | 300 | | | |
| | | | H11D3M | 200 | | | |
| BV _{CEO} | | No RBE, I _C = 1.0mA | 4N38M | 80 | | | |
| BV _{CBO} | Collector to Base ⁽²⁾ | I _C = 100μA, I _F = 0 | MOC8204M | 400 | | | V |
| | | | H11D1M/2M | 300 | | | |
| | | | H11D3M | 200 | | | |
| | | | 4N38M | 80 | | | |
| BV _{EBO} | Emitter to Base | I _E = 100μA, I _F = 0 | 4N38M | 7 | | | V |
| BV _{ECO} | Emitter to Collector | I _E = 100μA, I _F = 0 | All | 7 | 10 | | V |
| I _{CER} | Leakage Current Collector to Emitter ⁽²⁾ (R _{BE} = 1MΩ) | V _{CE} = 300V, I _F = 0, T _A = 25°C | MOC8204M | | | 100 | nA |
| | | V _{CE} = 300V, I _F = 0, T _A = 100°C | | | | 250 | μA |
| | | V _{CE} = 200V, I _F = 0, T _A = 25°C | H11D1M/2M | | | 100 | nA |
| | | V _{CE} = 200V, I _F = 0, T _A = 100°C | | | | 250 | μA |
| | | V _{CE} = 100V, I _F = 0, T _A = 25°C | H11D3M | | | 100 | nA |
| | | V _{CE} = 100V, I _F = 0, T _A = 100°C | | | | 250 | μA |
| I _{CEO} | | No RBE, V _{CE} = 60V, I _F = 0, T _A = 25°C | 4N38M | | | 50 | nA |

Transfer Characteristics (T_A = 25°C Unless otherwise specified.)

| Symbol | Characteristics | Test Conditions | Device | Min. | Typ.* | Max. | Units |
|------------------------|--|--|------------------------|--------|-------|------|--------|
| EMITTER | | | | | | | |
| CTR | Current Transfer Ratio, Collector to Emitter | I _F = 10mA, V _{CE} = 10V, R _{BE} = 1MΩ | H11D1M/2M/3M, MOC8204M | 2 (20) | | | mA (%) |
| | | I _F = 10mA, V _{CE} = 10V | 4N38M | 2 (20) | | | |
| V _{CE(SAT)} | Saturation Voltage ⁽²⁾ | I _F = 10mA, I _C = 0.5mA, R _{BE} = 1MΩ | H11D1M/2M/3M, MOC8204M | | 0.1 | 0.40 | V |
| | | I _F = 20mA, I _C = 4mA | 4N38M | | | 1.0 | |
| | | | | | | | |
| SWITCHING TIMES | | | | | | | |
| t _{ON} | Non-Saturated Turn-on Time | V _{CE} = 10V, I _{CE} = 2mA, R _L = 100Ω | All | | 5 | | μs |
| t _{OFF} | Turn-off Time | | All | | 5 | | μs |

*All Typical values at T_A = 25°C

Note:

2. Parameters meet or exceed JEDEC registered data (for 4N38M only).

DC Electrical Characteristics (Continued) ($T_A = 25^\circ\text{C}$ unless otherwise specified.)**Isolation Characteristics**

| Symbol | Characteristic | Test Conditions | Device | Min. | Typ.* | Max. | Units |
|-----------|-----------------------|--|--------|-----------|-------|------|--------------|
| V_{ISO} | Isolation Voltage | $f = 60\text{Hz}$, $t = 1 \text{ sec.}$ | All | 7500 | | | V_{ACPEAK} |
| R_{ISO} | Isolation Resistance | $V_{I-O} = 500 \text{ VDC}$ | All | 10^{11} | | | Ω |
| C_{ISO} | Isolation Capacitance | $f = 1\text{MHz}$ | All | | 0.2 | | pF |

*All Typical values at $T_A = 25^\circ\text{C}$ **Safety and Insulation Ratings**

As per IEC 60747-5-2, this optocoupler is suitable for "safe electrical insulation" only within the safety limit data. Compliance with the safety ratings shall be ensured by means of protective circuits.

| Symbol | Parameter | Min. | Typ. | Max. | Unit |
|------------|--|--------|-----------|------|------------|
| | Installation Classifications per DIN VDE 0110/1.89 Table 1 | | | | |
| | For Rated Main Voltage < 150Vrms | | I-IV | | |
| | For Rated Main voltage < 300Vrms | | I-IV | | |
| | Climatic Classification | | 55/100/21 | | |
| | Pollution Degree (DIN VDE 0110/1.89) | | 2 | | |
| CTI | Comparative Tracking Index | 175 | | | |
| V_{PR} | Input to Output Test Voltage, Method b, $V_{IORM} \times 1.875 = V_{PR}$, 100% Production Test with $t_m = 1 \text{ sec}$, Partial Discharge < 5pC | 1594 | | | V_{peak} |
| | Input to Output Test Voltage, Method a, $V_{IORM} \times 1.5 = V_{PR}$, Type and Sample Test with $t_m = 60 \text{ sec}$, Partial Discharge < 5pC | 1275 | | | V_{peak} |
| V_{IORM} | Max. Working Insulation Voltage | 850 | | | V_{peak} |
| V_{IOTM} | Highest Allowable Over Voltage | 6000 | | | V_{peak} |
| | External Creepage | 7 | | | mm |
| | External Clearance | 7 | | | mm |
| | Insulation Thickness | 0.5 | | | mm |
| RIO | Insulation Resistance at T_s , $V_{IO} = 500\text{V}$ | 10^9 | | | Ω |

Typical Performance Curves

Fig. 1 LED Forward Voltage vs. Forward Current

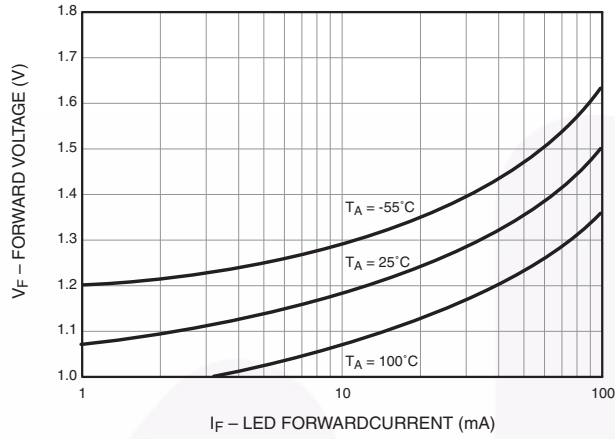


Fig. 2 Normalized Output Characteristics

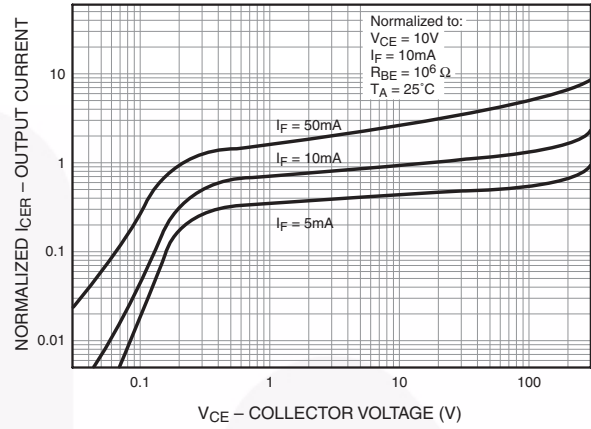


Fig. 3 Normalized Output Current vs. LED Input Current

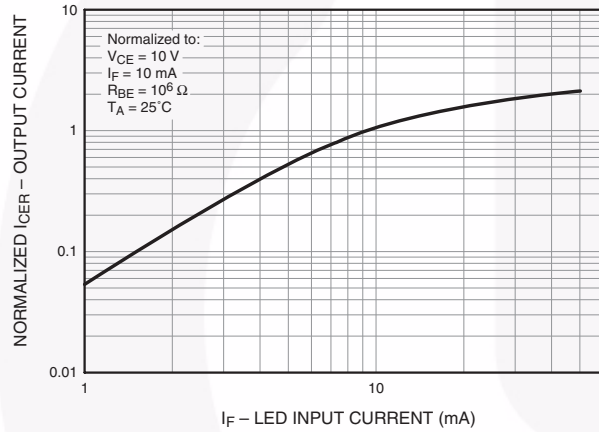


Fig. 4 Normalized Output Current vs. Temperature

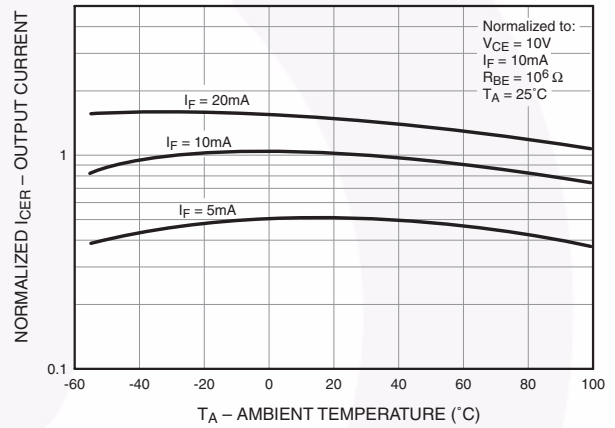


Fig. 5 Normalized Dark Current vs. Ambient Temperature

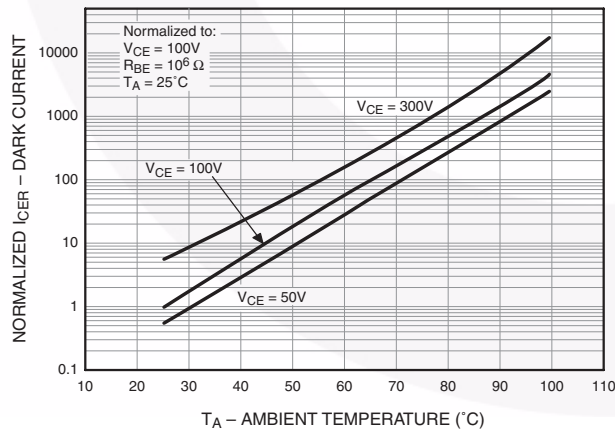
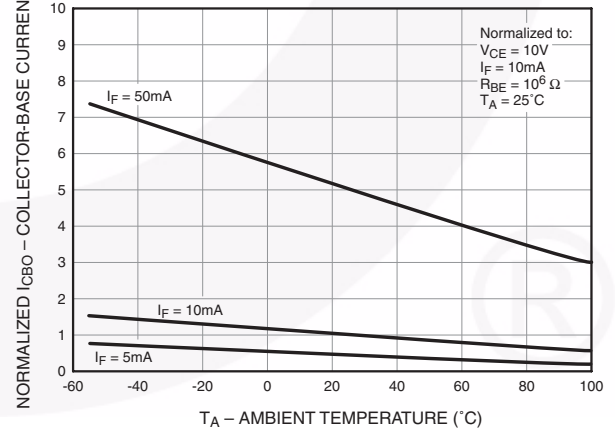
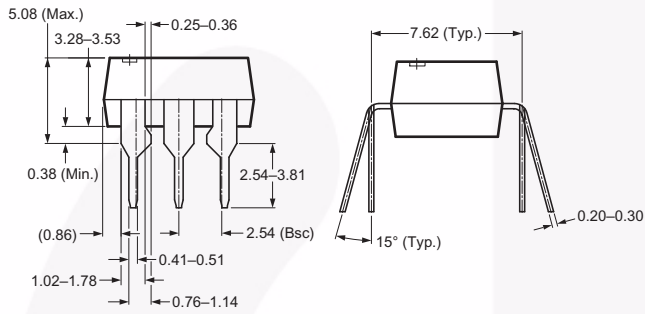
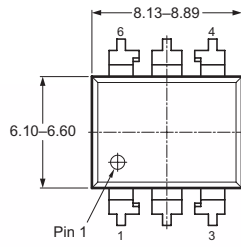


Fig. 6 Normalized Collector-Base Current vs. Temperature

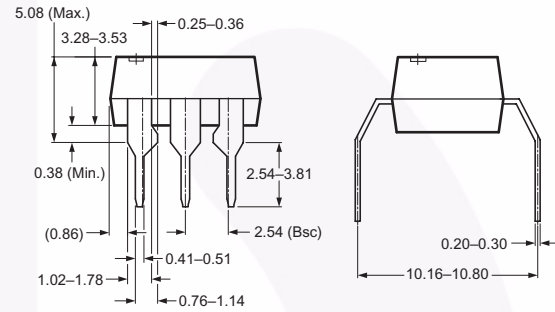
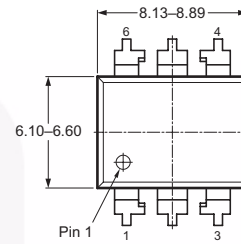


Package Dimensions

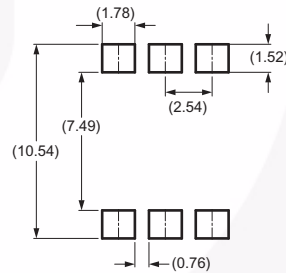
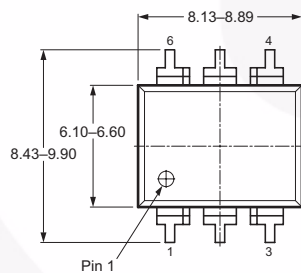
Through Hole



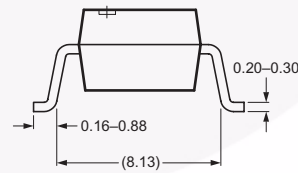
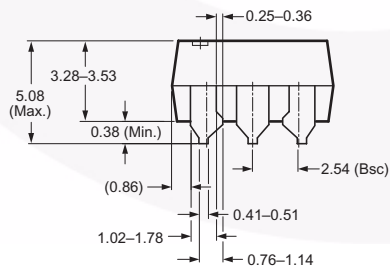
0.4" Lead Spacing



Surface Mount



Recommended Pad Layout

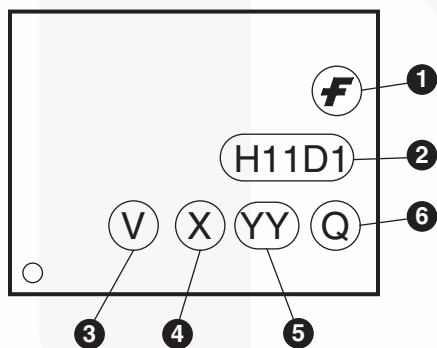


Note:
All dimensions in mm.

Ordering Information

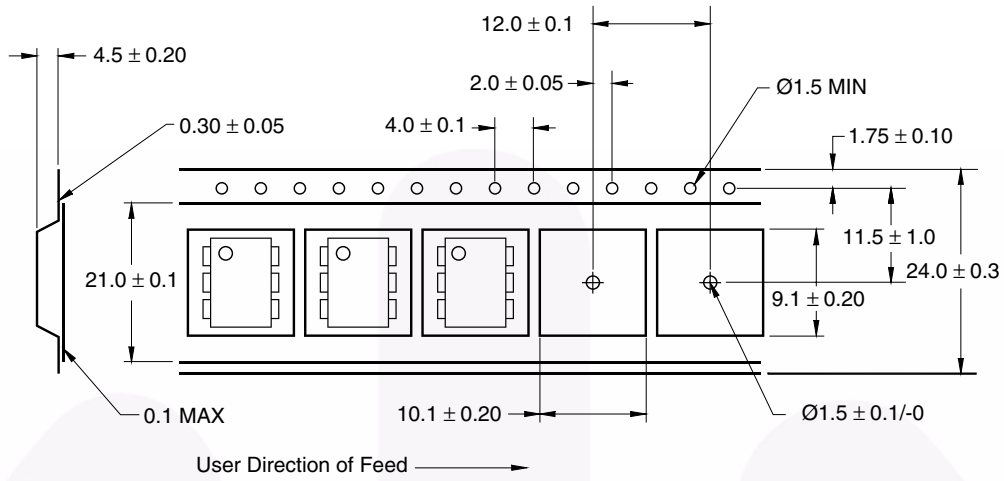
| Option | Order Entry Identifier (Example) | Description |
|-----------|----------------------------------|--|
| No option | H11D1M | Standard Through Hole Device (50 units per tube) |
| S | H11D1SM | Surface Mount Lead Bend |
| SR2 | H11D1SR2M | Surface Mount; Tape and Reel |
| T | H11D1TM | 0.4" Lead Spacing |
| V | H11D1VM | VDE 0884 |
| TV | H11D1TVM | VDE 0884, 0.4" Lead Spacing |
| SV | H11D1SVM | VDE 0884, Surface Mount |
| SR2V | H11D1SR2VM | VDE 0884, Surface Mount, Tape and Reel |

Marking Information

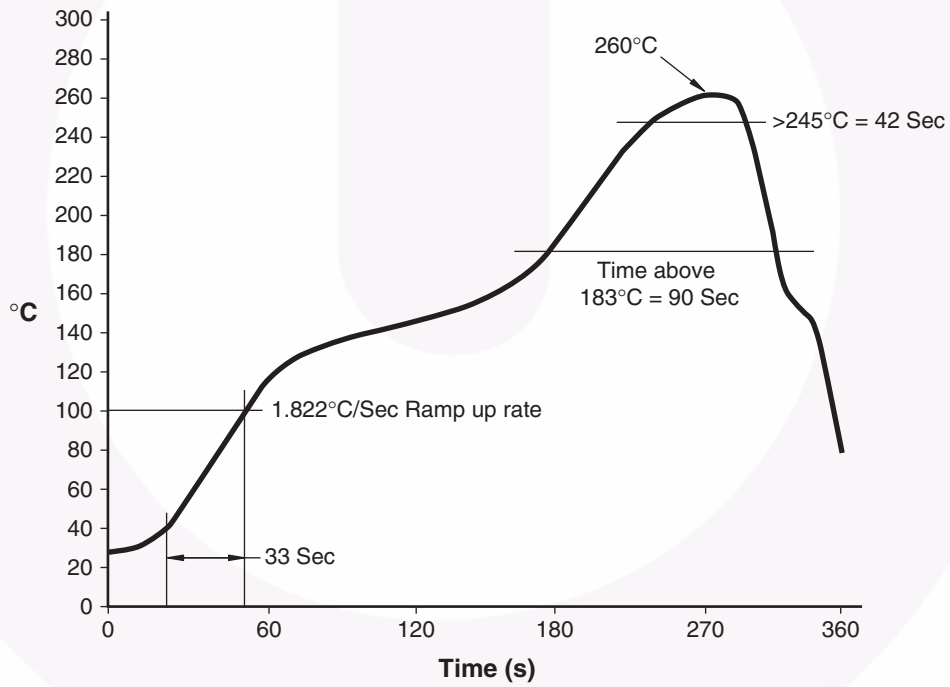


| Definitions | |
|-------------|--|
| 1 | Fairchild logo |
| 2 | Device number |
| 3 | VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table) |
| 4 | One digit year code, e.g., '7' |
| 5 | Two digit work week ranging from '01' to '53' |
| 6 | Assembly package code |

Carrier Tape Specification






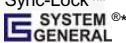
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| FPS™ | Power-SPM™ |  ™* | |

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Rev. I40