

Logic Diagram

### FEATURES:

- 24 independently switchable power FETs
- Low equivalent on resistance (200 mΩ typ)
- 2A switching current per channel
- No derating required to 90°C
- Total dose hardness: depending upon space mission in RAD-PAK®
- Package: 176-pin quad flat pack

### DESCRIPTION:

Maxwell Technologies 24SW multi-chip module (MCM) 24 channel MOSFET driver uses Maxwell Technologies' patented radiation-hardened RAD-PAK® MCM packaging technology. The 24SW is a radiation hardened MOSFET driver for space applications.

The 24SW incorporates twenty-four independent p-channel MOSFETs, along with interface components, that can switch up to 2A per channel. The  $R_{DS-ON}$  of the MOSFET is typically less than 200mΩ.

Maxwell Technologies' patented RAD-PAK® packaging technology incorporates radiation shielding in the micro-circuit package. It eliminates the need for box shielding while improving the TID performance in most space environments. This product is available with screening up to Maxwell Technologies self-defined Class K.

TABLE 1. 24SW PINOUT DESCRIPTION

| PIN | NAME      | FUNCTION                | NOTES                                   |
|-----|-----------|-------------------------|---|
| 1   | Pkg-Gnd   | Case Ground             | This pin is for grounding the case(lid) |
| 2   | TP1B      |                         |   |
| 3   | TP7D      |                         |   |
| 4   | TP1D      |                         |   |
| 5   | TP8D      |                         |   |
| 6   | TP2D      |                         |   |
| 7   | TP7E      |                         |   |
| 8   | TP1E      |                         |   |
| 9   | TP8E      |                         |   |
| 10  | SS_CMD_5  | Switch 5 Control Input  | TTL voltage level switch input          |
| 11  | SS_CMD_4  | Switch 4 Control Input  | TTL voltage level switch input          |
| 12  | SS_CMD_3  | Switch 3 Control Input  | TTL voltage level switch input          |
| 13  | TP2E      |                         |   |
| 14  | SS_CMD_2  | Switch 2 Control Input  | TTL voltage level switch input          |
| 15  | SS_CMD_1  | Switch 1 Control Input  | TTL voltage level switch input          |
| 16  | TP2B      |                         |   |
| 17  | SS_CMD_0  | Switch 0 Control Input  | TTL voltage level switch input          |
| 18  | TP38A     |                         |   |
| 19  | TP46A     |                         |   |
| 20  | TP38C     |                         |   |
| 21  | TP2C      |                         |   |
| 22  | TP2A      |                         |   |
| 23  | VDD       | +15V Power Supply       |   |
| 24  | TP38B     |                         |   |
| 25  | GND       | Analog Ground           |   |
| 26  | VSS       | -15V Power Supply       |   |
| 27  | TP38D     |                         |   |
| 28  | TP44D     |                         |   |
| 29  | SS_CMD_12 | Switch 12 Control Input | TTL voltage level switch input          |
| 30  | TP37D     |                         |   |
| 31  | SS_CMD_13 | Switch 13 Control Input | TTL voltage level switch input          |
| 32  | SS_CMD_14 | Switch 14 Control Input | TTL voltage level switch input          |

TABLE 1. 24SW PINOUT DESCRIPTION

| PIN | NAME      | FUNCTION                | NOTES                                   |
|-----|-----------|-------------------------|---|
| 33  | TP43D     |                         |   |
| 34  | SS_CMD_15 | Switch 15 Control Input | TTL voltage level switch input          |
| 35  | SS_CMD_16 | Switch 16 Control Input | TTL voltage level switch input          |
| 36  | SS_CMD_17 | Switch 17 Control Input | TTL voltage level switch input          |
| 37  | TP44C     |                         |   |
| 38  | TP44A     |                         |   |
| 39  | TP44B     |                         |   |
| 40  | TP37C     |                         |   |
| 41  | TP43E     |                         |   |
| 42  | TP37E     |                         |   |
| 43  | TP44E     |                         |   |
| 44  | TP38E     |                         |   |
| 45  | LD14_OUT  | Switch 14 Low Side      | FET Drain                               |
| 46  | LD14_IN   | Switch 14 High Side     | FET Source                              |
| 47  | PKG_GND   | Case Ground             | This pin is for grounding the case(lid) |
| 48  | LD15_OUT  | Switch 15 Low Side      | FET Drain                               |
| 49  | LD15_IN   | Switch 15 High Side     | FET Source                              |
| 50  | TP37A     |                         |   |
| 51  | LD12_OUT  | Switch 12 Low Side      | FET Drain                               |
| 52  | LD12_IN   | Switch 12 High Side     | FET Source                              |
| 53  | TP37B     |                         |   |
| 54  | LD18_OUT  | Switch 18 Low Side      | FET Drain                               |
| 55  | LD18_IN   | Switch 18 High Side     | FET Source                              |
| 56  | TP43A     |                         |   |
| 57  | LD13_OUT  | Switch 13 Low Side      | FET Drain                               |
| 58  | LD13_IN   | Switch 13 High Side     | FET Source                              |
| 59  | TP9A      |                         |   |
| 60  | TP3E      |                         |   |
| 61  | TP4E      |                         |   |
| 62  | TP10E     |                         |   |
| 63  | LD17_OUT  | Switch 17 Low Side      | FET Drain                               |
| 64  | LD17_IN   | Switch 17 High Side     | FET Source                              |
| 65  | TP10D     |                         |   |
| 66  | LD19_OUT  | Switch 19 Low Side      | FET Drain                               |
| 67  | LD19_IN   | Switch 19 High Side     | FET Source                              |
| 68  | TP4D      |                         |   |
| 69  | LD16_OUT  | Switch 16 Low Side      | FET Drain                               |

TABLE 1. 24SW PINOUT DESCRIPTION

| PIN | NAME      | FUNCTION                | NOTES                          |
|-----|-----------|-------------------------|--------------------------------|
| 70  | LD16_IN   | Switch 16 High Side     | FET Source                     |
| 71  | TP3D      |                         |                                |
| 72  | LD23_OUT  | Switch 23 Low Side      | FET Drain                      |
| 73  | LD23_IN   | Switch 23 High Side     | FET Source                     |
| 74  | TP9D      |                         |                                |
| 75  | TP41A     |                         |                                |
| 76  | TP41C     |                         |                                |
| 77  | TP46D     |                         |                                |
| 78  | LD21_OUT  | Switch 21 Low Side      | FET Drain                      |
| 79  | LD21_IN   | Switch 21 High Side     | FET Source                     |
| 80  | TP40D     |                         |                                |
| 81  | LD22_OUT  | Switch 22 Low Side      | FET Drain                      |
| 82  | LD22_IN   | Switch 22 High Side     | FET Source                     |
| 83  | TP39D     |                         |                                |
| 84  | TP45D     |                         |                                |
| 85  | LD20_OUT  | Switch 20 Low Side      | FET Drain                      |
| 86  | LD20_IN   | Switch 20 High Side     | FET Source                     |
| 87  | TP45E     |                         |                                |
| 88  | TP39E     |                         |                                |
| 89  | TP40E     |                         |                                |
| 90  | TP46E     |                         |                                |
| 91  | TP48D     |                         |                                |
| 92  | TP42D     |                         |                                |
| 93  | TP47D     |                         |                                |
| 94  | TP41D     |                         |                                |
| 95  | TP41E     |                         |                                |
| 96  | TP47E     |                         |                                |
| 97  | TP42E     |                         |                                |
| 98  | SS_CMD_18 | Switch 18 Control Input | TTL voltage level switch input |
| 99  | SS_CMD_19 | Switch 19 Control Input | TTL voltage level switch input |
| 100 | SS_CMD_20 | Switch 20 Control Input | TTL voltage level switch input |
| 101 | TP48E     |                         |                                |
| 102 | SS_CMD_21 | Switch 21 Control Input | TTL voltage level switch input |
| 103 | SS_CMD_22 | Switch 22 Control Input | TTL voltage level switch input |
| 104 | TP12B     |                         |                                |
| 105 | SS_CMD_23 | Switch 23 Control Input | TTL voltage level switch input |
| 106 | TP12A     |                         |                                |

TABLE 1. 24SW PINOUT DESCRIPTION

| PIN | NAME      | FUNCTION                | NOTES                          |
|-----|-----------|-------------------------|--------------------------------|
| 107 | TP48A     |                         |                                |
| 108 | VSS       | -15V Power Supply       |                                |
| 109 | GND       | Analog Ground           |                                |
| 110 | TP10C     |                         |                                |
| 111 | VDD       | +15V Power Supply       |                                |
| 112 | TP10A     |                         |                                |
| 113 | TP48B     |                         |                                |
| 114 | TP12C     |                         |                                |
| 115 | TP10B     |                         |                                |
| 116 | TP12D     |                         |                                |
| 117 | SS_CMD_11 | Switch 11 Control Input | TTL voltage level switch input |
| 118 | TP6D      |                         |                                |
| 119 | SS_CMD_10 | Switch 10 Control Input | TTL voltage level switch input |
| 120 | SS_CMD_9  | Switch 9 Control Input  | TTL voltage level switch input |
| 121 | TP11D     |                         |                                |
| 122 | SS_CMD_8  | Switch 8 Control Input  | TTL voltage level switch input |
| 123 | SS_CMD_7  | Switch 7 Control Input  | TTL voltage level switch input |
| 124 | SS_CMD_6  | Switch 6 Control Input  | TTL voltage level switch input |
| 125 | TP5D      |                         |                                |
| 126 | TP12E     |                         |                                |
| 127 | TP6E      |                         |                                |
| 128 | TP11E     |                         |                                |
| 129 | TP5E      |                         |                                |
| 130 | TP6C      |                         |                                |
| 131 | TP6A      |                         |                                |
| 132 | TP6B      |                         |                                |
| 133 | LD11_OUT  | Switch 11 Low Side      | FET Drain                      |
| 134 | LD11_IN   | Switch 11 High Side     | FET Source                     |
| 135 | TP11C     |                         |                                |
| 136 | LD10_OUT  | Switch 10 Low Side      | FET Drain                      |
| 137 | LD10_IN   | Switch 10 High Side     | FET Source                     |
| 138 | TP11A     |                         |                                |
| 139 | LD9_OUT   | Switch 9 Low Side       | FET Drain                      |
| 140 | LD19_IN   | Switch 9 High Side      | FET Source                     |
| 141 | TP11B     |                         |                                |
| 142 | LD7_OUT   | Switch 7 Low Side       | FET Drain                      |
| 143 | LD7_IN    | Switch 7 High Side      | FET Source                     |

TABLE 1. 24SW PINOUT DESCRIPTION

| PIN | NAME    | FUNCTION           | NOTES      |
|-----|---------|--------------------|------------|
| 144 | TP5C    |                    |            |
| 145 | LD8_OUT | Switch 8 Low Side  | FET Drain  |
| 146 | LD8_IN  | Switch 8 High Side | FET Source |
| 147 | TP5A    |                    |            |
| 148 | TP5B    |                    |            |
| 149 | TP9C    |                    |            |
| 150 | TP9A    |                    |            |
| 151 | LD4_OUT | Switch 4 Low Side  | FET Drain  |
| 152 | LD4_IN  | Switch 4 High Side | FET Source |
| 153 | TP9B    |                    |            |
| 154 | LD6_OUT | Switch 6 Low Side  | FET Drain  |
| 155 | LD6_IN  | Switch 6 High Side | FET Source |
| 156 | TP3C    |                    |            |
| 157 | LD5_OUT | Switch 5 Low Side  | FET Drain  |
| 158 | LD5_IN  | Switch 5 High Side | FET Source |
| 159 | TP3A    |                    |            |
| 160 | LD2_OUT | Switch 2 Low Side  | FET Drain  |
| 161 | LD2_IN  | Switch 2 High Side | FET Source |
| 162 | TP3B    |                    |            |
| 163 | TP8C    |                    |            |
| 164 | TP8A    |                    |            |
| 165 | TP8B    |                    |            |
| 166 | LD0_OUT | Switch 0 Low Side  | FET Drain  |
| 167 | LD0_IN  | Switch 0 High Side | FET Source |
| 168 | TP7C    |                    |            |
| 169 | LD3_OUT | Switch 3 Low Side  | FET Drain  |
| 170 | LD3_IN  | Switch 3 High Side | FET Source |
| 171 | TP7A    |                    |            |
| 172 | TP7B    |                    |            |
| 173 | LD1_OUT | Switch 1 Low Side  | FET Drain  |
| 174 | LD1_IN  | Switch 1 High Side | FET Source |
| 175 | TP1C    |                    |            |
| 176 | TP1A    |                    |            |

TABLE 2. 24SW ABSOLUTE MAXIMUM RATINGS

| PARAMETER   | SYMBOL        | MIN   | MAX  | UNIT |
|---|---------------|-------|------|------|
| Supply Voltage Range                                  | $V_{15V}$     | --    | 16.5 | V    |
|   | $V_{-15V}$    | -16.5 | --   | V    |
| Switch Input Voltage Range                            |               | -1.0  | 40   | V    |
| Storage Temperature Range                             | $T_S$         | -55   | 125  | °C   |
| Operational Temperature Range                         | $T_A$         | -40   | 110  | °C   |
| Maximum Power Dissipation<br>Per Switch<br>Per Module | $P_D$         | --    | 2.04 | W    |
|   |               | --    | 10.0 |      |
| Thermal Resistance, Junction to Mounting Base of Case | $\Theta_{JC}$ | --    | 6.5  | °C/W |
| Junction Temperature                                  | $T_J$         | --    | 125  | °C   |

TABLE 3. 24SW RECOMMENDED OPERATING CONDITIONS

| PARAMETER   | SYMBOL     | MIN        | MAX            | UNIT |
|---|------------|------------|----------------|------|
| Supply Voltage Range  | $V_{15V}$  | 13.5       | 16.5           | V    |
|   | $V_{-15V}$ | -13.5      | -16.5          | V    |
| Control Input High Voltage                                    | $V_{IH}$   | 2.4        | $V_{5V} + 0.5$ | V    |
| Control Input Low Voltage                                     | $V_{IL}$   | DGND - 0.5 | 0.8            | V    |
| Operational Temperature Range (Case temperature) <sup>1</sup> | $T_A$      | -40        | 110            | °C   |
| Power Dissipation   | $P_D$      | --         | 6.5            | W    |

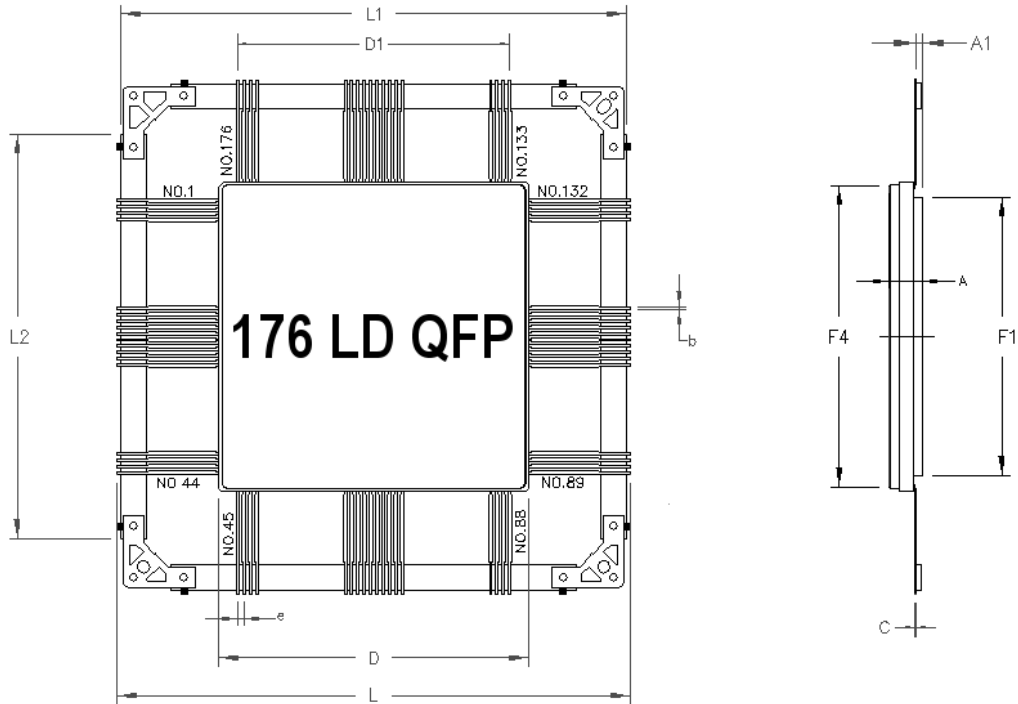
1. As long as the 125 °C junction temperature limit is not exceeded.

TABLE 4. 24SW ELECTRICAL CHARACTERISTICS  
 ( $V_{15V} = 15V$ ,  $V_{-15V} = -15V$ ,  $T_A = -40$  TO  $110^\circ C$ , UNLESS OTHERWISE SPECIFIED)

| PARAMETER  | SYMBOL         | CONDITIONS  | SUBGROUPS | MIN   | NOM | MAX  | UNIT               |
|--|----------------|---|-----------|-------|-----|------|--------------------|
| Control Input High Voltage   | $V_{IH}$       | Results in turning FET switch -ON (closed)                    | 1, 2, 3   | 2.4   | --  | --   | V                  |
| Control Input Low Voltage  | $V_{IL}$       | Results in turning FET switch -OFF (Open)                     | 1, 2, 3   | --    | --  | 0.8  | V                  |
|  | $I_{15V}$      | All 24 switches OFF   | 1, 2, 3   | --    | --  | 3.0  | mA                 |
|  | $I_{-15V}$     | All 24 switches OFF   | 1, 2, 3   | --    | --  | 3.0  | mA                 |
|  | $I_{15V}$      | For each switch that is ON <sup>1</sup>                       | 1, 2, 3   | 135   | 200 | 240  | $\mu A$ per switch |
|  | $I_{-15V}$     | For each switch that is ON <sup>1</sup>                       | 1, 2, 3   | 310   | 475 | 590  | $\mu A$ per switch |
| Switching Voltage (Ground side switching is acceptable) <sup>2</sup> | $V_{SW}$       | Referenced to Power Ground                                    | 1, 2, 3   | -1.0  | 28  | 37   | V                  |
| Switching Current  | $I_{SW-POWER}$ | Load Switching Range  | 1, 2, 3   | 0.002 | --  | 2.0  | A                  |
| Equivalent ON resistance per switch                                  | $R_{ON}$       | Switch input voltage = 28V, Current = 2 amps                  | 1, 2, 3   | --    | 200 | 325  | $m\Omega$          |
| Switching Leakage Current for OFF state                              | $I_{SWOFF}$    | Switch input voltage = 37V, $T_j$ temperature = $125^\circ C$ | 1, 2, 3   | --    | --  | 0.25 | mA                 |
| Turn ON Time (Rise time)   | $t_{ON}$       | Switch input voltage = 28V, Load current = 1 amp              | 1, 2, 3   | 100   | --  | 500  | $\mu S$            |
| Turn OFF Time (Fall time)  | $t_{OFF}$      | Switch input voltage = 28V, load current = 0.1 amps           | 1, 2, 3   | 50    | --  | 350  | $\mu S$            |

1. Total current = current per SW x # of SW + bias current.
2. Power Gnd, DGND and AGND all must be within 0.7V of each other.





176 PIN RAD-PAK® QUAD FLAT PACKAGE

| SYMBOL | DIMENSION |          |       |
|--------|-----------|----------|-------|
|        | Min       | Nom      | Max   |
| A      | 0.239     | 0.264    | 0.289 |
| b      | 0.028     | 0.030    | 0.032 |
| c      | 0.010     | 0.012    | 0.014 |
| D      | 2.425     | 2.450 SQ | 2.475 |
| D1     | 2.150     |          |       |
| e      | 0.050 BSC |          |       |
| L      | 4.025     | 4.040    | 4.045 |
| L1     | 3.985     | 4.000    | 4.005 |
| L2     | 3.168     | 3.200    | 3.232 |
| A1     | 0.051     | 0.058    | 0.065 |
| F1     | 2.195     | 2.200    | 2.205 |
| F4     | 2.395     | 2.400    | 2.405 |
| N      | 176       |          |       |

Q176-01

Note: All dimensions in inches

### Important Notice:

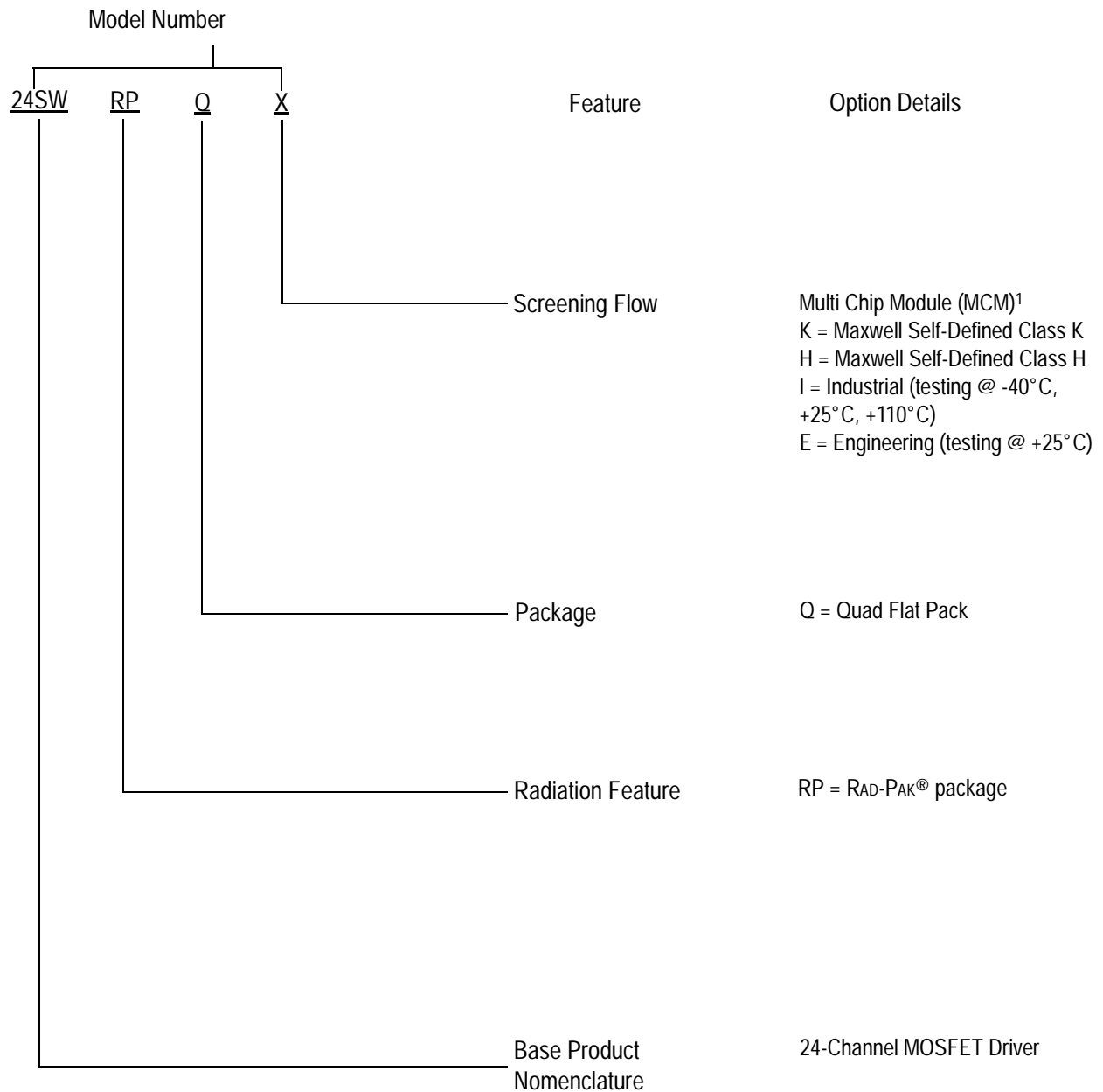
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Product Ordering Options



1) Products are manufactured and screened to Maxwell Technologies self-defined Class H and Class K flows.