# Current-Limited Power Distribution Switches

## General Description

The EM5203 series is an N-channel MOSFET high-side power switch without parasitic body diode between drain and source. The EM5203AJ-20 provides very low on-resistance as 60mΩ and continuously delivers up to 1.5A output current. The fault flag output function indicates fault conditions to the local USB controller. The other features include soft start, current limit protection, Power-On-Reset function, and over temperature protection. The EM5203 series is available in SOT23-3, SOT23-5 and DFN1.8X2.0-06 package.

## Ordering Information

| Part Number | Package | Remark |
|---|---|---|
| EM5203BJS-02A | SOT23-3 | 0.2A |
| EM5203AJ-02A | SOT23-5 | 0.2A/Active High |
| EM5203J-02A | SOT23-5 | 0.2A/Active Low |
| EM5203AVK6-02A | DFN1.8X2.0-06 | 0.2A/Active High |
| EM5203VK6-02A | DFN1.8X2.0-06 | 0.2A/Active Low |
| EM5203AJ-05A | SOT23-5 | 0.5A/Active High |
| EM5203J-05A | SOT23-5 | 0.5A/Active Low |
| EM5203AVK6-05A | DFN1.8X2.0-06 | 0.5A/Active High |
| EM5203VK6-05A | DFN1.8X2.0-06 | 0.5A/Active Low |
| EM5203AJ-10A | SOT23-5 | 1A/Active High |
| EM5203J-10A | SOT23-5 | 1A/Active Low |
| EM5203AJ-15A | SOT23-5 | 1.5A/Active High |
| EM5203J-15A | SOT23-5 | 1.5A/Active Low |

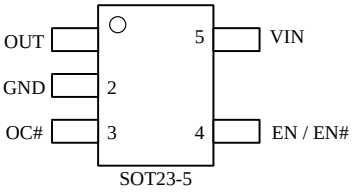
## Features

- Wide Input Range 2.5V to 5.5V
- Low MOSFET On Resistance
- 2us Short Protection Response
- Low Quiescent(65uA) & Shutdown Current
- Deglitched Open-Drain Fault Flag Output
- Reverse Current Flow blocking
- Power On Reset Function
- Current Limit Protection
- Over Temperature Protection
- Soft Start and Fast turn off
- Reverse Voltage Protection
- Enable Active High or Active Low
- UL Recognized, File No.E468218
- Halogen Free

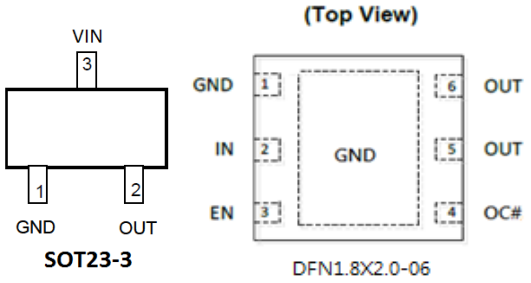
## Applications

- USB
- Notebook & Netbook &MB

## Pin Configuration

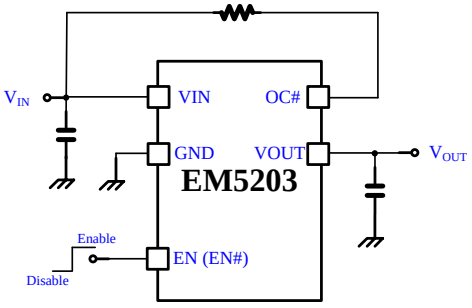



SOT23-5




DFN1.8X2.0-06

## Typical Application Circuit




Note: A low ESR 100uF capacitor between VOUT & GND is recommended.

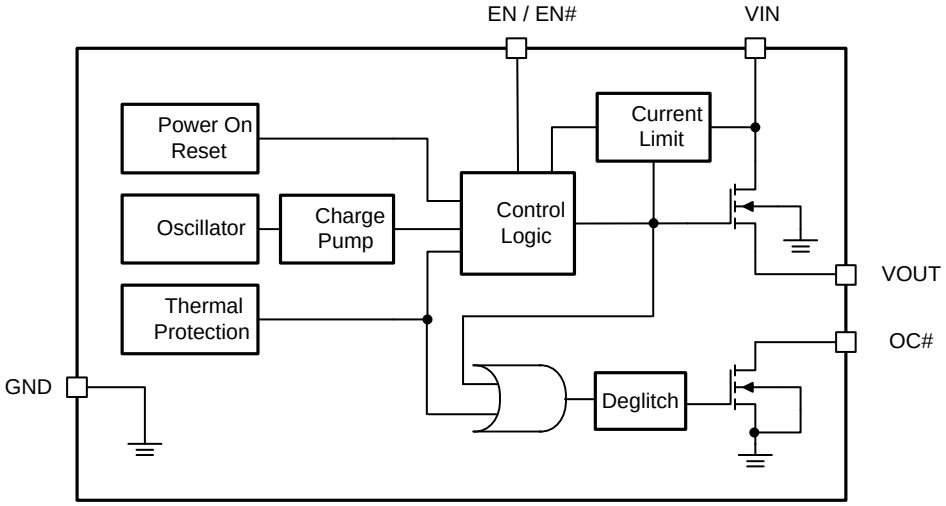
## Selection table

| Part Number | Current | Discharge Function | Soft-Start Time | EN Function | | Package | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Active High | Active Low | SOT23-3 | SOT23-5 | DFN1.8X2.0-06 |
| EM5203BJS-02A | 0.2A | Y | 0.5ms | | | V | | |
| EM5203AJ-02A | 0.2A | Y | 0.5ms | V | | | V | |
| EM5203J-02A | 0.2A | Y | 0.5ms | | V | | V | |
| EM5203AVK6-02A | 0.2A | Y | 0.5ms | V | | | | V |
| EM5203VK6-02A | 0.2A | Y | 0.5ms | | V | | | V |
| EM5203AJ-05A | 0.5A | Y | 0.5ms | V | | | V | |
| EM5203J-05A | 0.5A | Y | 0.5ms | | V | | V | |
| EM5203AVK6-05A | 0.5A | Y | 0.5ms | V | | | | V |
| EM5203VK6-05A | 0.5A | Y | 0.5ms | | V | | | V |
| EM5203AJ-10A | 1A | Y | 0.5ms | V | | | V | |
| EM5203J-10A | 1A | Y | 0.5ms | | V | | V | |
| EM5203AJ-15A | 1.5A | Y | 0.5ms | V | | | V | |
| EM5203J-15A | 1.5A | Y | 0.5ms | | V | | V | |

## Pin Assignment

| Pin Name | Pin No. SOT23-5 | Pin No. SOT23-3 | Pin No. DFN1.8X2.0-06 | Pin Function |
|---|---|---|---|---|
| GND | 2 | 1 | 1 | **Ground.** |
| VIN | 5 | 3 | 2 | **Input Voltage.** This is the drain input to the power device that supplies current to the output pin. Minimum 1uF low ESR ceramic capacitor is recommended at this pin. |
| EN / EN# | 4 | - | 3 | **Chip Enable Input** (Active high for EN, Active low for EN#) |
| OC# | 3 | - | 4 | **OC Flag Output.** This is an open-drain output and is set low impedance once current limit or over temperature protection enabled. No connect is not used. |
| VOUT | 1 | 2 | 5, 6 | **Output Voltage.** VOUT is power output pin. |

## Function Block Diagram



## Absolute Maximum Ratings (Note1)

- $V_{IN}$ ---------- -0.3V to +6.0V
- Other Pins---------- -0.3V to ($V_{IN}$+0.3V)
- Power Dissipation, $P_D$ @ $T_A$ = 25°C, SOT23-5 ---------- 0.4W
- Package Thermal Resistance, $\theta_{JA}$, SOT23-5 (Note 2)---------- 250°C/W
- Junction Temperature---------- 150°C
- Lead Temperature (Soldering, 10 sec.)---------- 260°C
- Storage Temperature ---------- –65°C to 150°C
- ESD susceptibility (Note3)
  HBM (Human Body Mode)---------- 2KV
  MM (Machine Mode)---------- 200V

## Recommended Operating Conditions (Note4)

- Supply Input Voltage, $V_{IN}$ ---------- +2.5V to +5.5V
- Junction Temperature ---------- –40°C to 125°C
- Ambient Temperature ---------- –40°C to 85°C

## Electrical Characteristics

$V_{IN}$=5V, $T_A$=25℃, unless otherwise specified

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Supply Input Section** | | | | | | |
| POR Threshold | $V_{PORTH}$ | | - | 2.2 | 2.5 | V |
| Quiescent Current | $I_Q$ | $I_{OUT}$=0A | - | 65 | 120 | uA |
| Shutdown Current | $I_{SD}$ | EN#=5V | - | 0.1 | 1 | uA |
| **Output Voltage** | | | | | | |
| On Resistance | $R_{ON}$ | For EM5203BJS-02A | | 110 | 140 | mΩ |
| | | For EM5203AJ/J-02A<br>For EM5203AVK6/VK6-02A | | 85 | 100 | mΩ |
| | | For EM5203AJ/J-05A<br>For EM5203AVK6/VK6-05A | | 85 | 100 | mΩ |
| | | For EM5203AJ/J-10A/15A | | 85 | 100 | mΩ |
| Reverse Leakage Current | IRev | VOUT=5V , VIN=0V | - | 0.1 | 2 | uA |
| Soft-Start Time | Tss | Rising from 10% to 90%<br>$C_L$ =1uF ; $R_{LOAD}$ =10Ω | | 0.5 | 1.5 | ms |
| Turn On Delay Time | Td | EN high to Vo 10%, VIN=5V,<br>$C_L$ =1uF ; $R_{LOAD}$ =10Ω | | 200 | | us |
| **Enable** | | | | | | |
| Enable High Level | $V_{EN}$ | | 1.2 | - | - | V |
| Disable Low Level | $V_{SD}$ | | - | - | 0.5 | V |
| EN Input Current | $I_{EN}$ | | - | 0.1 | 1 | uA |
| **OC# Flag Output** | | | | | | |
| OC# Output Resistance | $R_{FLGB}$ | $I_{SINK}$=1mA | - | 20 | 80 | Ω |
| OC# Off Current | $I_{FLGB\_OFF}$ | $V_{FLGB}$=5V | - | 0.1 | 1 | uA |
| OC# Delay Time | $T_D$ | | 4 | 8 | 20 | ms |
| OUT Shutdown Discharge Resistance | RDIS | | | 100 | | Ω |
| **Protection** | | | | | | |
| OCP Threshold Level | $I_{OCP}$ | EM5203-02 | 0.3 | 0.4 | 0.65 | A |
| Output Short Circuit Current | $I_{SC}$ | | | 0.3 | | A |
| OCP Threshold Level | $I_{OCP}$ | EM5203-05 | 0.6 | 0.8 | 1.2 | A |
| Output Short Circuit Current | $I_{SC}$ | | | 0.5 | | A |
| OCP Threshold Level | $I_{OCP}$ | EM5203-10 | 1.1 | 1.3 | 1.8 | A |
| Output Short Circuit Current | $I_{SC}$ | | | 0.8 | | A |
| OCP Threshold Level | $I_{OCP}$ | EM5203-15 | 1.6 | 1.8 | 2.4 | A |
| Output Short Circuit Current | $I_{SC}$ | | | 1.2 | | A |
| Thermal Shutdown Temperature | $T_{SD}$ | | - | 160 | - | °C |
| Thermal Shutdown Hysteresis | $T_{SDHYS}$ | | - | 30 | - | °C |

**Note 1.** Stresses listed as the above "Absolute Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibility to affect device reliability.

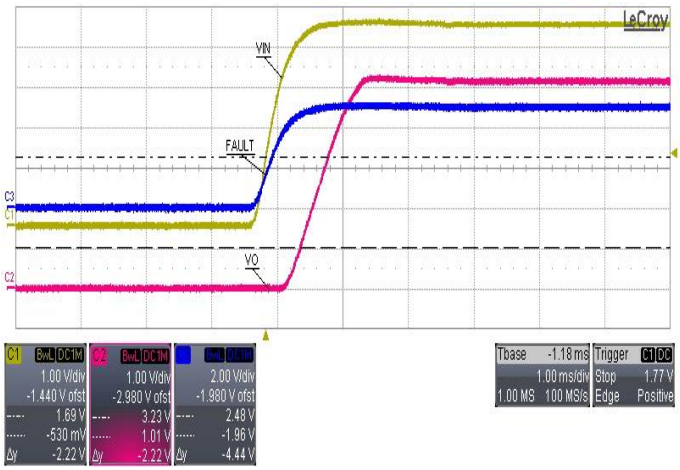
**Note 2.** $\theta_{JA}$ is measured in the natural convection at $T_A$=25°C on a low effective thermal conductivity test board (Single layout, 1S) of JEDEC 51-3 thermal measurement standard.

**Note 3.** Devices are ESD sensitive. Handling precaution is recommended.

**Note 4.** The device is not guaranteed to function outside its operating conditions.

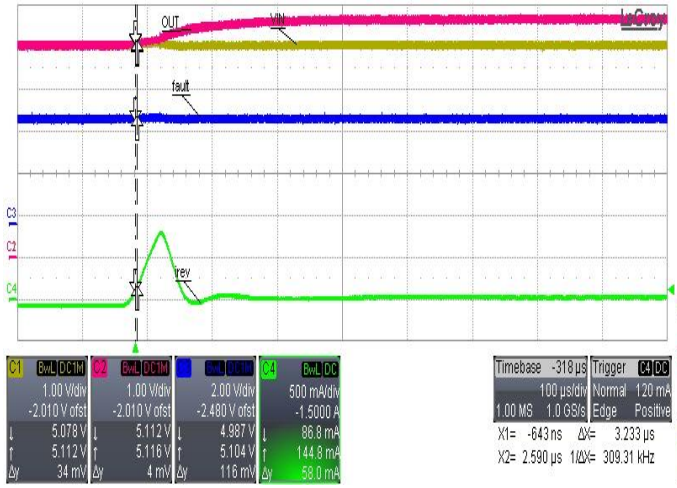
# Typical Operating Characteristics

**Turn on from VIN#**
**CH1: VIN, CH2:Vo, CH3:OC#**

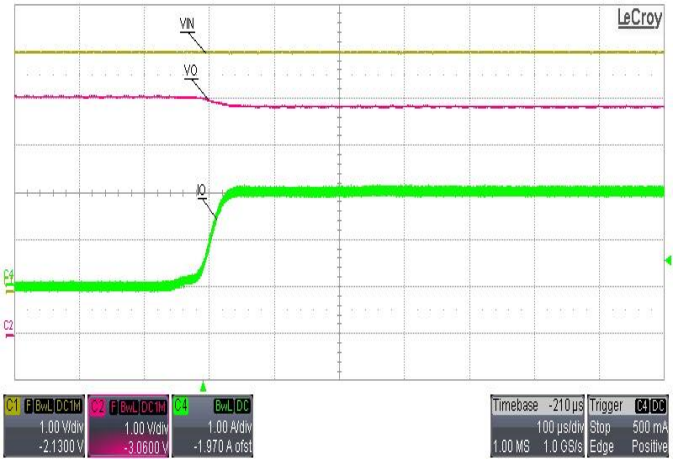



**Turn off from VIN#**
**CH1: VIN, CH2:Vo, CH3:OC#**

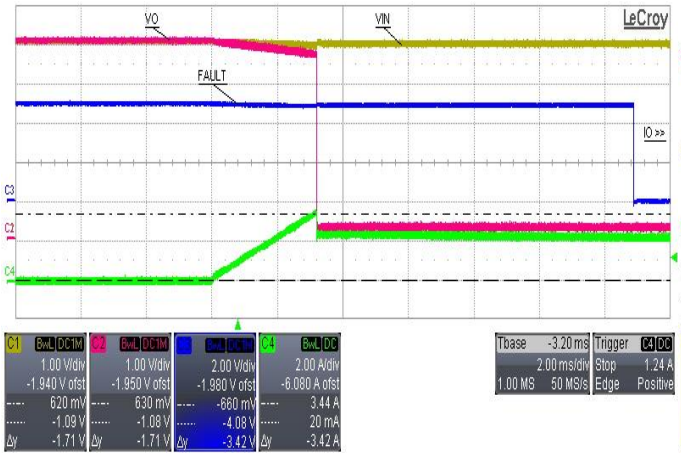

**Reverse Voltage Protection**
**CH1:VIN, CH2:Vo, CH3: OC# ,CH4:IREV**



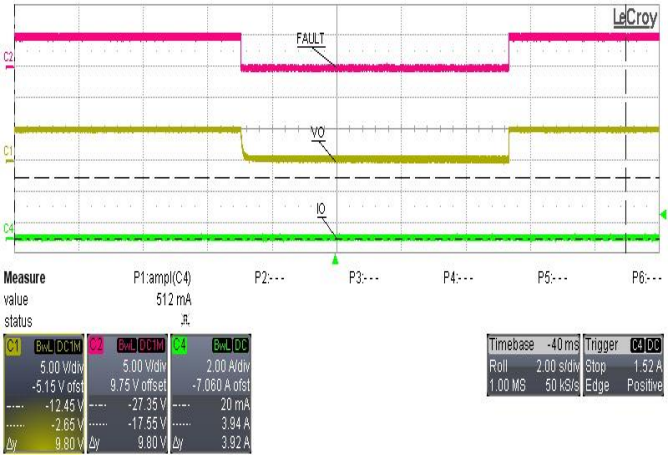

**Normal operating 2A output current**
**CH1:Vo, CH2:Fault, CH4:Io**




**Fault Signal delay time**
**CH1:VIN, CH2:VO, CH3:OC#,CH4:Io**

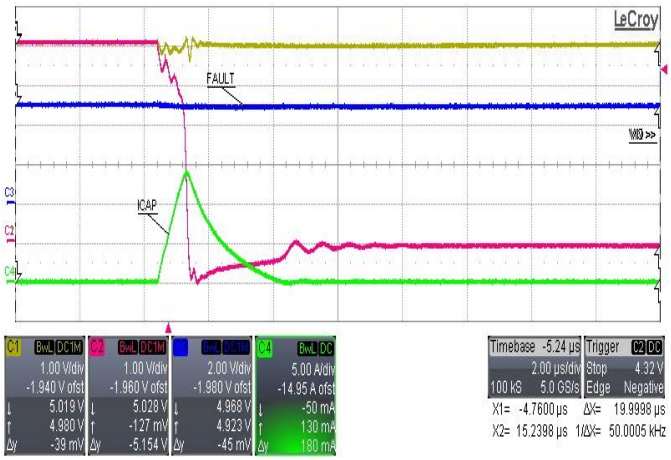



**Fault Signal during OTP occurs**
**CH1:Vo, CH2:OC#, CH4:Io**

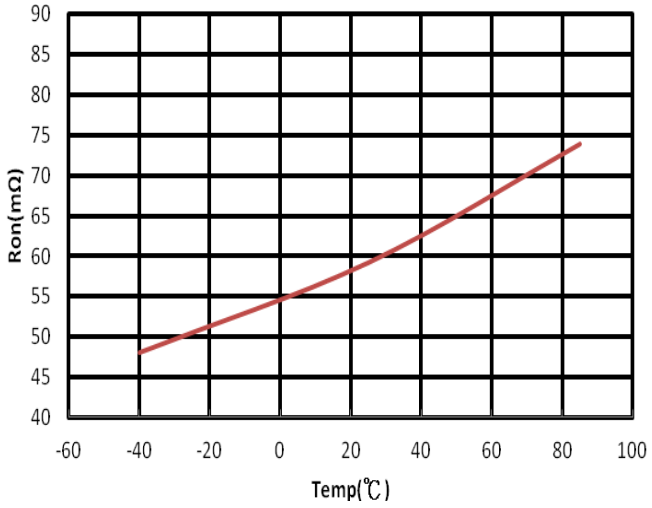


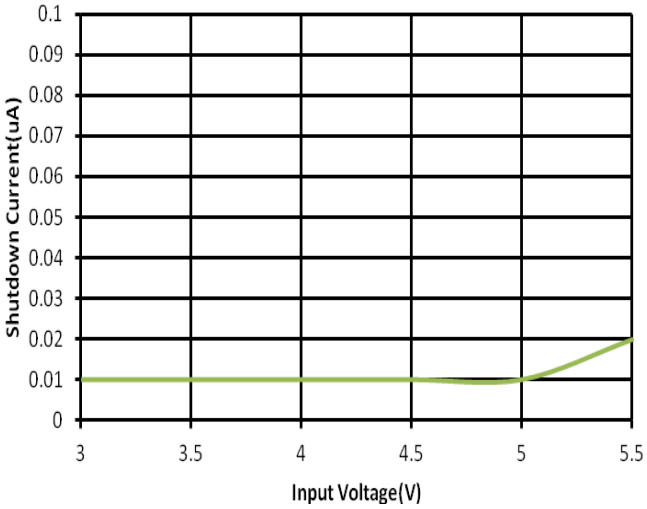
## Typical Operating Characteristics

**2uS Response for Output short Protection**
**CH1:VIN, CH2:Vo, CH3:OC#, CH4: IO**

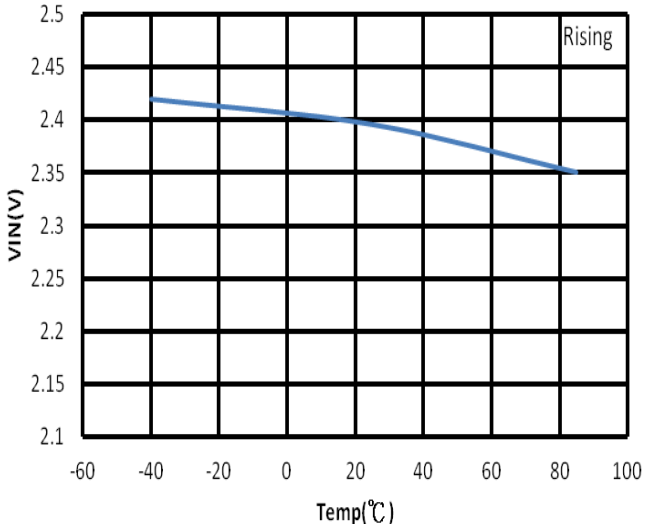



**RON Performance VS Temperature**
**EM5203-20 series**

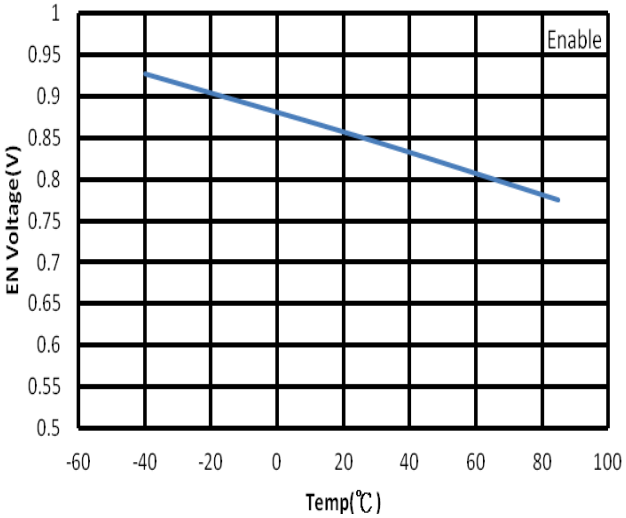



**UVLO ON Voltage VS Temperature**

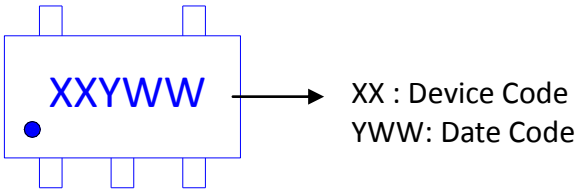



**Enable Voltage VS Temperature**



## Ordering & Marking Information

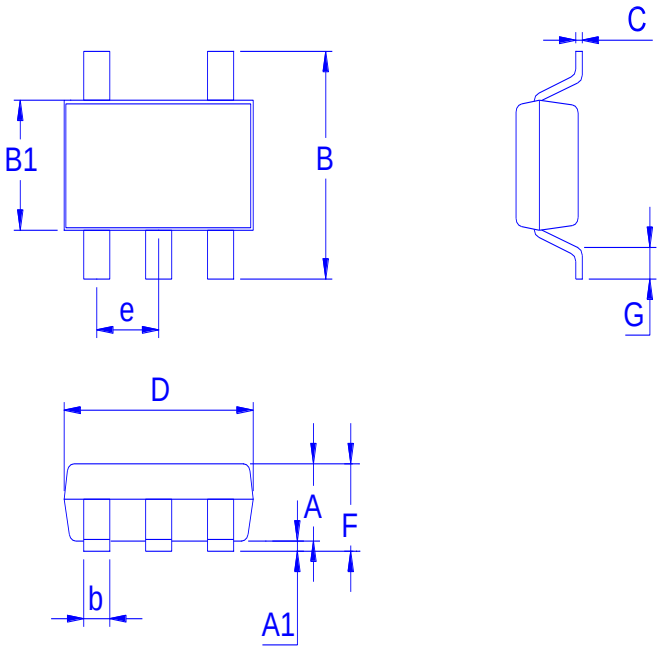
Device Name: EM5203 for SOT23-5




Device Code

| XX | Part Number |
|---|---|
| KQ | EM5203AJ-02A |
| KM | EM5203AJ-05A |
| KK | EM5203AJ-10A |
| KP | EM5203J-02A |
| KN | EM5203J-05A |
| KL | EM5203J-10A |
| NG | EM5203J-15A |

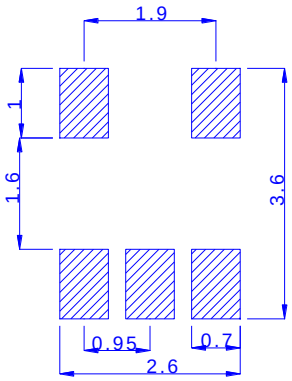
## Outline Drawing



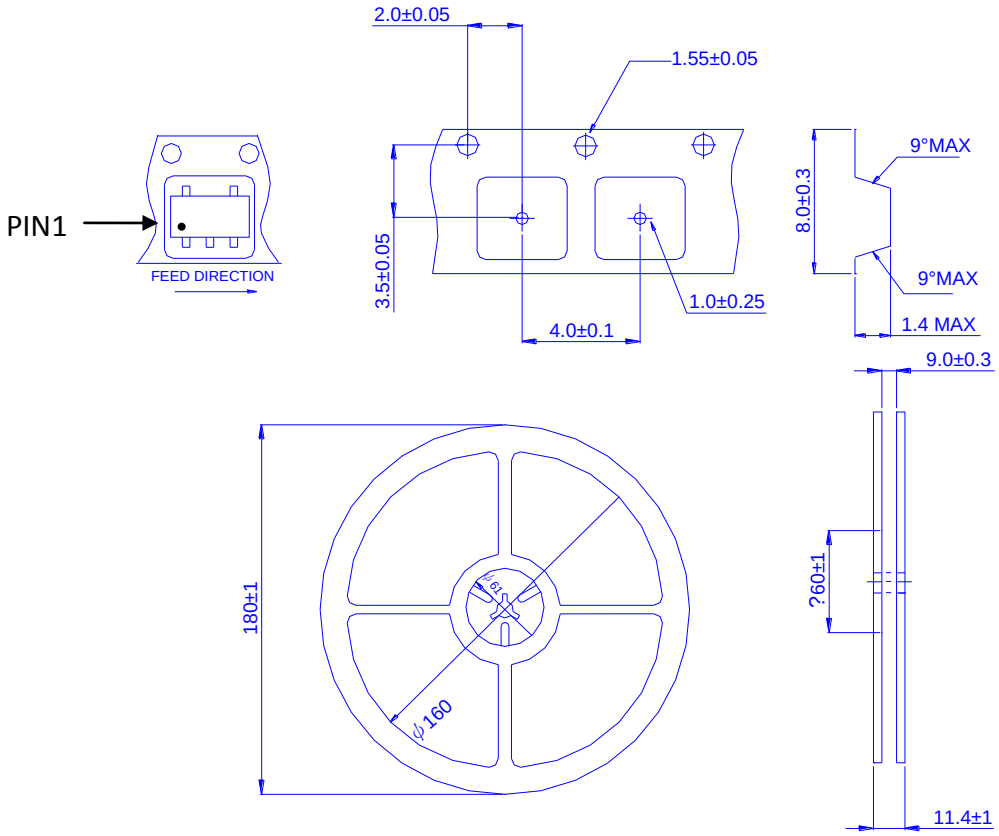

Dimension in mm

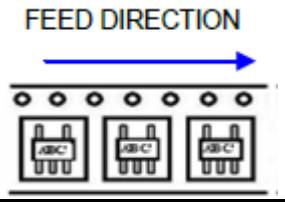
| Dimension | A | A1 | B | B1 | b | C | D | e | F | G |
|---|---|---|---|---|---|---|---|---|---|---|
| Min. | 0.9 | 0 | 2.6 | 1.5 | 0.3 | 0.08 | 2.8 | 0.87 | 1 | 0.3 |
| Typ. | 1.1 | 0.04 | 2.8 | 1.6 | 0.4 | 0.127 | 2.9 | 0.95 | 1.225 | 0.45 |
| Max. | 1.3 | 0.15 | 3 | 1.726 | 0.5 | 0.22 | 3.026 | 1.03 | 1.45 | 0.6 |

Recommended minimum pads



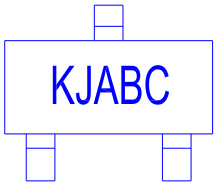
◆ Tape&Reel Information:3000pcs/Reel(Dimension in millimeter)




| | |
|---|---|
| Package | SOT23-5 |
| Reel Dimensions | 7” |
| Pin1 Orientation |   |
| Leader Empty Pockets | 50 |
| Trailer Empty Pockets | 50 |
| Quantity per Reel | 3K |
| Reel / Inner Box | 5：1 |
| Quantity per Inner Box | 15K |
| Inner Box/ Outer Carton | 12：1 |
| Quantity per Outer Carton | 180K |

## Ordering & Marking Information:

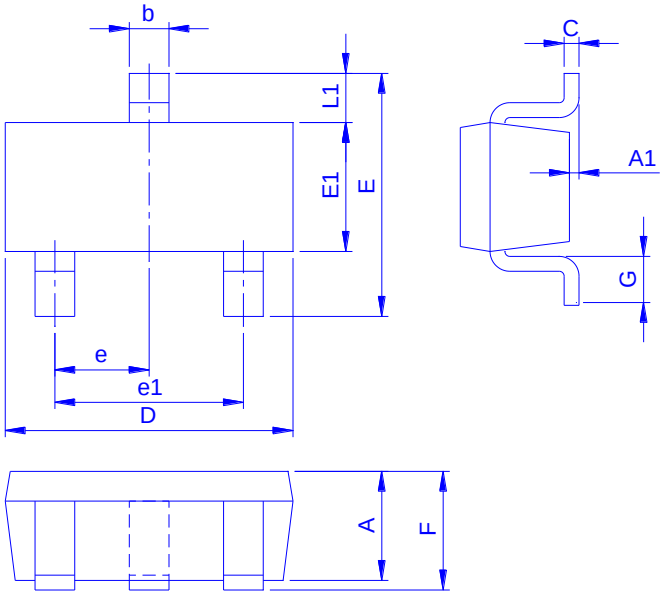
Device Name: EM5203BJS for SOT23-3




KJ: Device Code, KJ for EM5203BJS-02A

ABC: Date Code

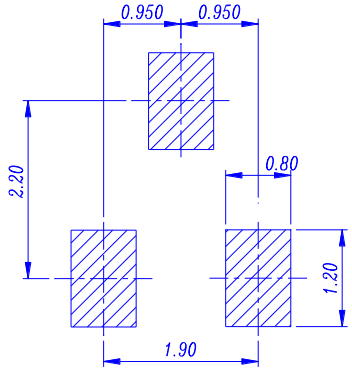
## Outline Drawing



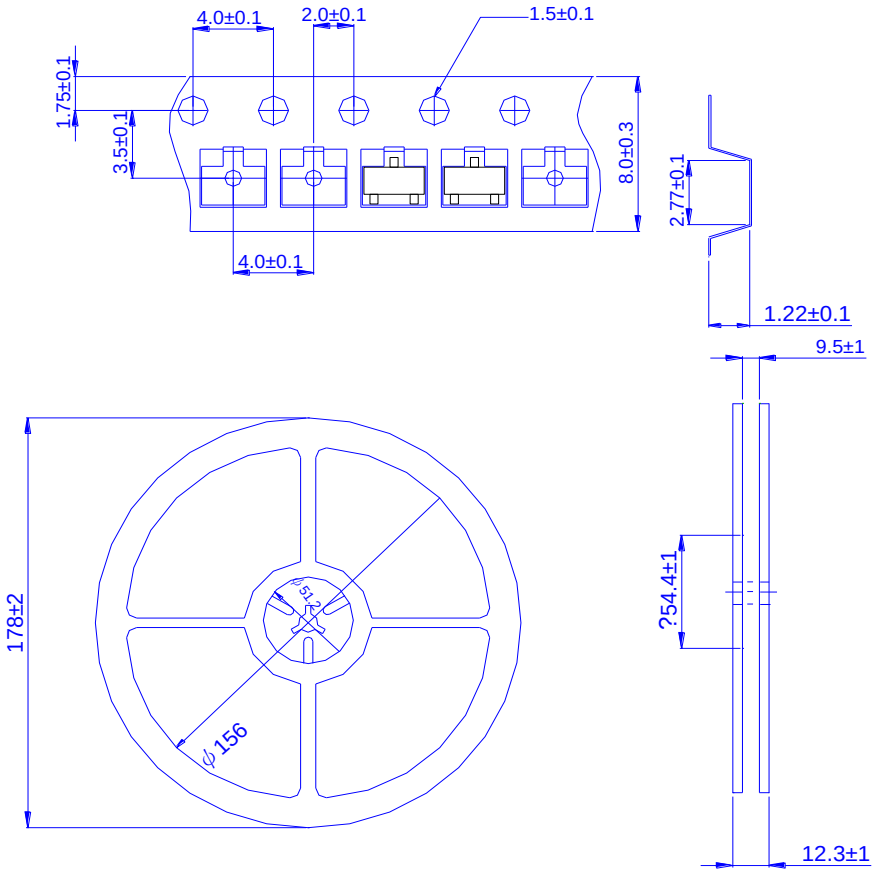

Dimension in mm

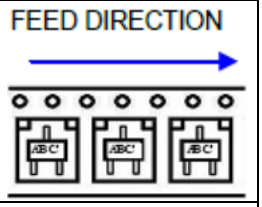
| Dimension | A | A1 | b | C | D | E | E1 | e | e1 | F | G | L1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Min. | 0.70 | 0 | 0.3 | 0.08 | 2.80 | 2.25 | 1.2 | 0.90 | | 0.80 | 0.3 | 0.50 |
| Typ. | | | | | 2.90 | | | 0.95 | 1.9 | | | |
| Max. | 1.15 | 0.1 | 0.5 | 0.20 | 3.02 | 3.00 | 1.7 | 1.00 | | 1.25 | 0.6 | 0.75 |

Recommended minimum pads



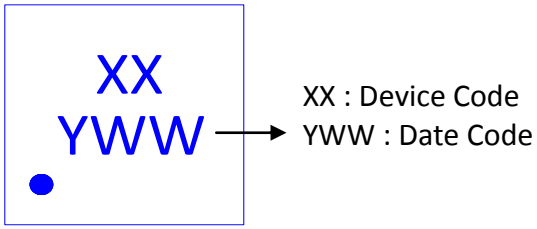
◆ Tape&Reel Information:3000pcs/Reel(Dimension in millimeter)




| | |
|---|---|
| Package | SOT23-3 |
| Reel Dimensions | 7” |
| Pin1 Orientation |   |
| Leader Empty Pockets | 50 |
| Trailer Empty Pockets | 50 |
| Quantity per Reel | 3K |
| Reel / Inner Box | 5：1 |
| Quantity per Inner Box | 15K |
| Inner Box/ Outer Carton | 12：1 |
| Quantity per Outer Carton | 180K |

## Ordering & Marking Information:

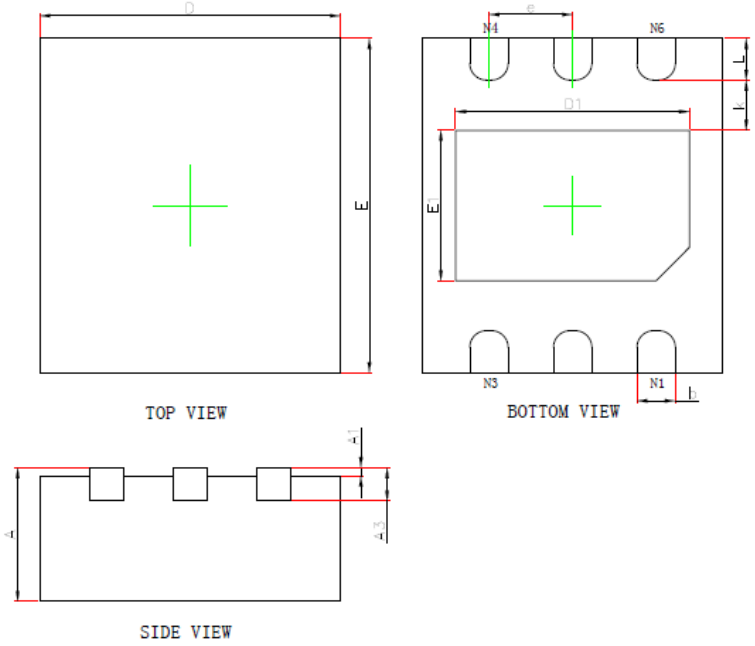
Device Name: EM5203 for DFN1.8X2.0-06




Device Code

| XX | Part Number |
|---|---|
| KV | EM5203AVK6-02A |
| KW | EM5203VK6-02A |
| KX | EM5203AVK6-05A |
| KY | EM5203VK6-05A |

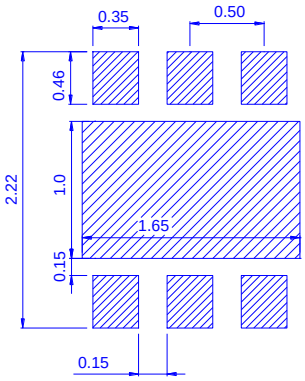
## Outline Drawing



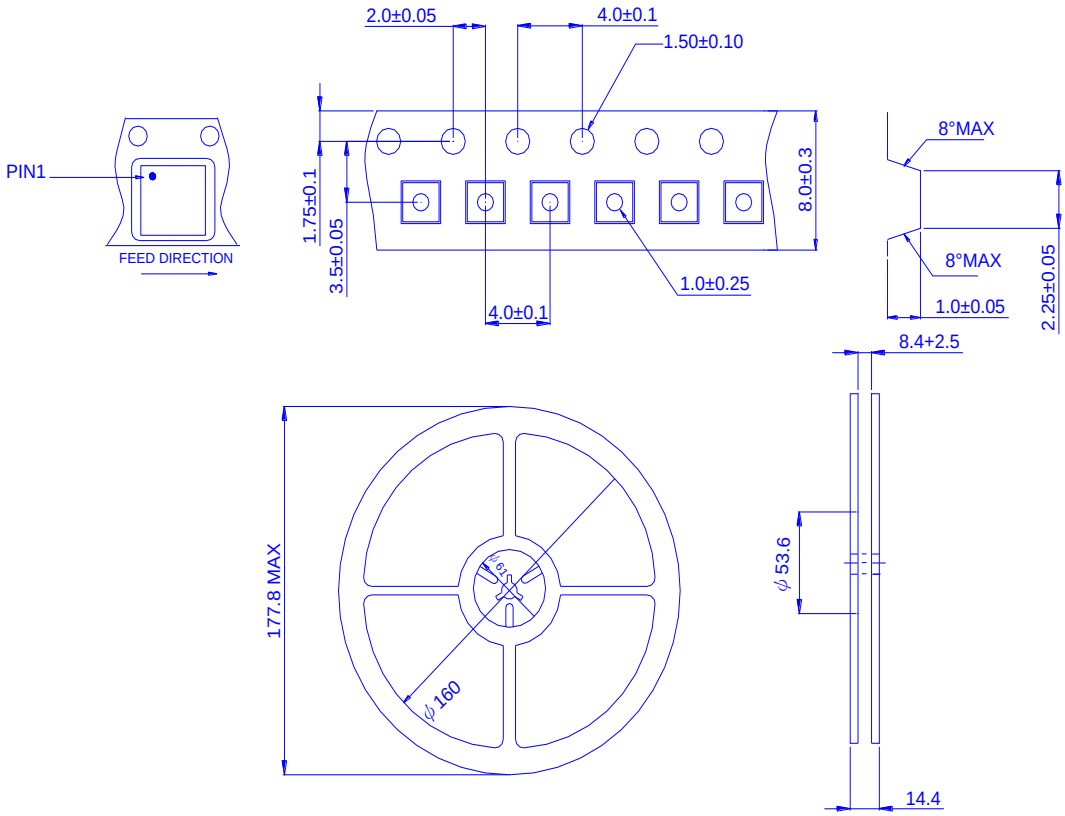

## Dimension in mm

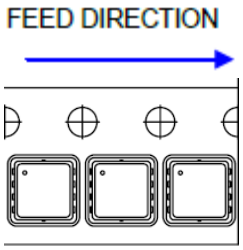
| Dimension | A | A1 | A3 | b | D | E | D1 | E1 | e | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Min. | 0.5 | 0 | | 0.15 | 1.7 | 1.9 | 1.3 | 0.8 | | | 0.174 |
| Typ. | 0.55 | 0.02 | 0.1 | 0.25 | 1.8 | 2 | 1.45 | 0.9 | 0.5 | 0.2 | 0.25 |
| Max. | 0.6 | 0.05 | | 0.35 | 1.9 | 2.1 | 1.6 | 1.0 | | | 0.326 |

## Recommended minimum pads



◆ Tape&Reel Information:3000pcs/Reel(Dimension in millimeter)




| | |
|---|---|
| Package | DFN1.8X2.0-06 |
| Reel Dimensions | 7” |
| Pin1 Orientation |   |
| Leader Empty Pockets | 50 |
| Trailer Empty Pockets | 50 |
| Quantity per Reel | 3K |
| Reel / Inner Box | 5：1 |
| Quantity per Inner Box | 15K |
| Inner Box/ Outer Carton | 12：1 |
| Quantity per Outer Carton | 180K |