# SGM4553
# 2-Bit Bidirectional Voltage-Level Translator for Open-Drain and Push-Pull Applications

## GENERAL DESCRIPTION

This two-bit non-inverting translator is a bidirectional voltage-level translator and can be used to establish digital switching compatibility between mixed-voltage systems. It uses two separate configurable power-supply rails, with the A ports supporting operating voltages from 1.65V to 5.5V while it tracks the $V_{CCA}$ supply, and the B ports supporting operating voltages from 2.3V to 5.5V while it tracks the $V_{CCB}$ supply. This allows the support of both lower and higher logic signal levels while providing bidirectional translation capabilities between any of the 1.8V, 2.5V, 3.3V, and 5V voltage nodes.

When the output-enable (OE) input is low, all I/Os are placed in the high-impedance state, which significantly reduces the power-supply quiescent current consumption. OE has an internal pull-down current source, as long as $V_{CCA}$ is powered.

To ensure the high-impedance state during power up or power down, OE should be tied to GND through a pull-down resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

The SGM4553 is available in the Green SOT-23-8 and XTDFN-1.4×1-8L packages. It operates over an ambient temperature range of -40℃ to +85℃.

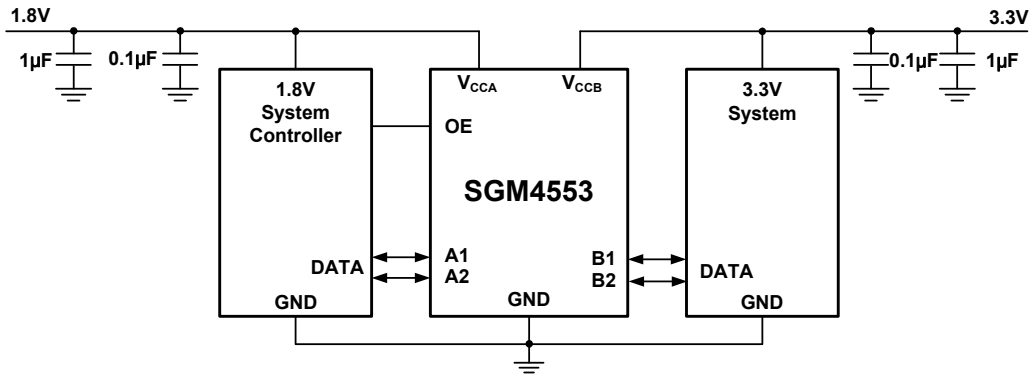
## FEATURES

- **No Direction-Control Signal Needed**
- **Data Rates**
  **24Mbps (Push-Pull)**
  **2Mbps (Open-Drain)**
- **1.65V to 5.5V on A Ports and 2.3V to 5.5V on B Ports ($V_{CCA} \le V_{CCB}$)**
- **$V_{CC}$ Isolation: If Either $V_{CC}$ is at GND, Both Ports are in the High-Impedance State**
- **No Power-Supply Sequencing Required: Either $V_{CCA}$ or $V_{CCB}$ can be Ramped First**
- **$I_{OFF}$: Supports Partial-Power-Down Mode Operation**
- **Available in Green SOT-23-8 and XTDFN-1.4×1-8L Packages**

## APPLICATIONS

$I^2C$/SMBus
UART
GPIO

## TYPICAL APPLICATION CIRCUIT



## PACKAGE/ORDERING INFORMATION

| MODEL | PACKAGE DESCRIPTION | ORDERING NUMBER | PACKAGE MARKING | PACKAGE OPTION |
|---|---|---|---|---|
| SGM4553 | SOT-23-8 | SGM4553YN8G/TR | SLDXX | Tape and Reel, 3000 |
| | XTDFN-1.4×1-8L | SGM4553YXDO8G/TR | N2X | Tape and Reel, 5000 |

NOTE: **X** = Date Code, **XX** = Date Code.

**MARKING INFORMATION**

**SLD X X**

Date code - Month ("A" = Jan. "B" = Feb. ⋯ "L" = Dec.)
Date code - Year ("A" = 2010, "B" = 2011 ⋯)
Chip I.D.

For example: SLDDB (2013, February)

## ABSOLUTE MAXIMUM RATINGS

$V_{CCA}$, Supply Voltage Range..... -0.3V to 6V
$V_{CCB}$, Supply Voltage Range..... -0.3V to 6V
$V_I$, A Ports, B Ports, OE Input Voltage Range (2).....-0.3V to 6V
$V_O$, Voltage Range Applied to Any Output in the High-Impedance or Power-Off State (2)
A Ports..... -0.3V to 6V
B Ports.....-0.3V to 6V
$V_O$, Voltage Range Applied to Any Output in the High or Low State (2) (3)
A Ports.....-0.3V to $V_{CCA}$ + 0.3V
B Ports.....-0.3V to $V_{CCB}$ + 0.3V
$I_{IK}$, Input Clamp Current ($V_I$ < 0) .....-50mA
$I_{OK}$, Output Clamp Current ($V_O$ < 0) .....-50mA
$I_O$, Continuous Output Current.....±50mA
Continuous Current through $V_{CCA}$, $V_{CCB}$, or GND.....…±100mA
Operating Temperature Range..... -40℃ to +85℃
Junction Temperature..... 150℃
Storage Temperature Range..... -65℃ to +150℃
Lead Temperature (Soldering, 10sec)..... 260℃
ESD Susceptibility
HBM.....4000V
MM.....300V

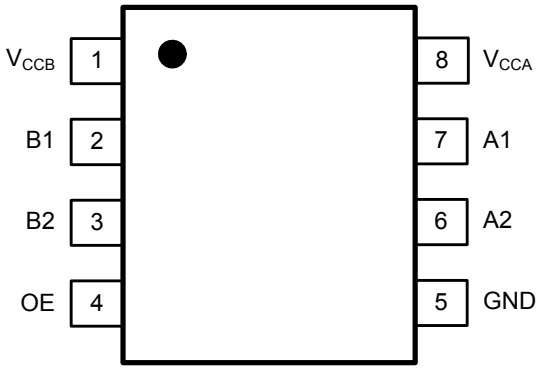
NOTES:
1. Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute Maximum rating conditions for extended periods may affect device reliability.
2. The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
3. The value of $V_{CCA}$ and $V_{CCB}$ are provided in the recommended operating conditions table.

## CAUTION

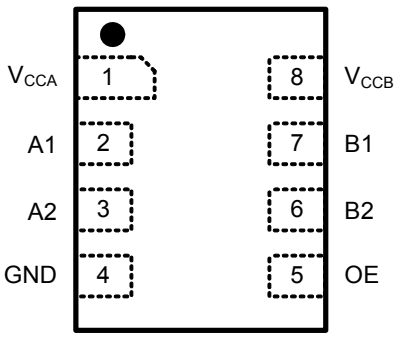
This integrated circuit can be damaged by ESD if you don’t pay attention to ESD protection. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

SGMICRO reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time. Please contact SGMICRO sales office to get the latest datasheet.

## PIN CONFIGURATIONS (TOP VIEW)




SOT-23-8




XTDFN-1.4×1-8L

## PIN DESCRIPTION

| PIN | | NAME | FUNCTION |
|---|---|---|---|
| SOT-23-8 | XTDFN-1.4×1-8L | | |
| 1 | 8 | $V_{CCB}$ | B Ports Supply Voltage. 2.3V ≤ $V_{CCB}$ ≤ 5.5V. |
| 2 | 7 | B1 | Input/Output B. Referenced to $V_{CCB}$. |
| 3 | 6 | B2 | Input/Output B. Referenced to $V_{CCB}$. |
| 4 | 5 | OE | Output Enable (Active High). Pull OE low to place all outputs in 3-state mode. Referenced to $V_{CCA}$. |
| 5 | 4 | GND | Ground. |
| 6 | 3 | A2 | Input/Output A. Referenced to $V_{CCA}$. |
| 7 | 2 | A1 | Input/Output A. Referenced to $V_{CCA}$. |
| 8 | 1 | $V_{CCA}$ | A Ports Supply Voltage. 1.65V ≤ $V_{CCA}$ ≤ 5.5V and $V_{CCA}$ ≤ $V_{CCB}$. |

# ELECTRICAL CHARACTERISTICS

($V_{CCA}$ = 1.65V to 5.5V, $V_{CCB}$ = 2.3V to 5.5V, Full = -40℃ to +85℃, typical values are at $T_A$ = +25℃, unless otherwise noted.)

| PARAMETER | | CONDITIONS | | TEMP | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|---|
| **RECOMMENDED OPERATING CONDITIONS** (1) (2) | | | | | | | | |
| Supply Voltage (3) | $V_{CCA}$ | | | Full | 1.65 | | 5.5 | V |
| | $V_{CCB}$ | | | Full | 2.3 | | 5.5 | |
| High-Level Input Voltage ($V_{IH}$) | A Port I/Os | $V_{CCA}$ = 1.65V to 1.95V, $V_{CCB}$ = 2.3V to 5.5V | | Full | $V_{CCI}$ - 0.2 | | $V_{CCI}$ | V |
| | | $V_{CCA}$ = 2.3V to 5.5V, $V_{CCB}$ = 2.3V to 5.5V | | Full | $V_{CCI}$ - 0.4 | | $V_{CCI}$ | |
| | B Port I/Os | | | Full | $V_{CCI}$ - 0.4 | | $V_{CCI}$ | |
| | OE Input | | | Full | $V_{CCA}$ × 0.8 | | 5.5 | |
| Low-Level Input Voltage ($V_{IL}$) | A Port I/Os | | | Full | 0 | | 0.15 | V |
| | B Port I/Os | | | Full | 0 | | 0.15 | |
| | OE Input | | | Full | 0 | | $V_{CCA}$ × 0.25 | |
| Input Transition Rise or Fall Rate (Δt/ΔV) | | A Port I/Os Push-Pull Driving | | Full | | | 10 | ns/V |
| | | B Port I/Os Push-Pull Driving | | Full | | | 10 | |
| | | Control Input | | Full | | | 10 | |
| **ELECTRICAL CHARACTERISTICS** | | | | | | | | |
| A Ports High Level Output Voltage ($V_{OHA}$) | | $I_{OH}$ = -20μA, $V_{IB}$ ≥ $V_{CCB}$ - 0.4V | | Full | $V_{CCA}$ × 0.7 | | | V |
| A Ports Low Level Output Voltage ($V_{OLA}$) | | $I_{OL}$ = 1mA, $V_{IB}$ ≤ 0.15V | | Full | | | 0.4 | |
| B Ports High Level Output Voltage ($V_{OHB}$) | | $I_{OH}$ = -20μA, $V_{IA}$ ≥ $V_{CCA}$ - 0.4V | | Full | $V_{CCB}$ × 0.7 | | | |
| B Ports Low Level Output Voltage ($V_{OLB}$) | | $I_{OL}$ = 1mA, $V_{IA}$ ≤ 0.15V | | Full | | | 0.4 | |
| Input Leakage Current ($I_I$) | OE | | | +25℃ | | | ±1 | μA |
| | | | | Full | | | ±1.5 | |
| Power Off Leakage Current ($I_{OFF}$) | A Ports | $V_{CCA}$ = 0V, $V_{CCB}$ = 0V to 5.5V | | +25℃ | | | ±0.5 | μA |
| | | | | Full | | | ±1 | |
| | B Ports | $V_{CCA}$ = 0V to 5.5V, $V_{CCB}$ = 0V | | +25℃ | | | ±0.5 | |
| | | | | Full | | | ±1 | |
| 3-State Output Leakage ($I_{OZ}$) | A or B Ports | OE = 0V | | +25℃ | | | ±0.6 | μA |
| | | | | Full | | | ±1 | |
| Quiescent Supply Current ($I_{CCA}$) | | $V_I$ = $V_O$ = OPEN, $I_O$ = 0 | $V_{CCA}$ = 1.65V to $V_{CCB}$, $V_{CCB}$ = 2.3V to 5.5V | Full | | | 5.5 | μA |
| | | | $V_{CCA}$ = 5.5V, $V_{CCB}$ = 0V | Full | | | 5.5 | |
| | | | $V_{CCA}$ = 0V, $V_{CCB}$ = 5.5V | Full | | | -1 | |
| Quiescent Supply Current ($I_{CCB}$) | | $V_I$ = $V_O$ = OPEN, $I_O$ = 0 | $V_{CCA}$ = 1.65V to $V_{CCB}$, $V_{CCB}$ = 2.3V to 5.5V | Full | | | 15 | μA |
| | | | $V_{CCA}$ = 5.5V, $V_{CCB}$ = 0V | Full | | | -1 | |
| | | | $V_{CCA}$ = 0V, $V_{CCB}$ = 5.5V | Full | | | 6 | |
| Quiescent Supply Current ($I_{CCA}$ + $I_{CCB}$) | | $V_I$ = $V_O$ = OPEN, $I_O$ = 0 | $V_{CCA}$ = 1.65V to $V_{CCB}$, $V_{CCB}$ = 2.3V to 5.5V | Full | | | 20 | μA |

# ELECTRICAL CHARACTERISTICS

($V_{CCA}$ = 1.65V to 5.5V, $V_{CCB}$ = 2.3V to 5.5V, Full = -40℃ to +85℃, typical values are at $T_A$ = +25℃, unless otherwise noted.)

| PARAMETER | CONDITIONS | | TEMP | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| Quiescent Supply Current ($I_{CCZA}$) | $V_I$ = $V_{CCI}$ or 0V, $I_O$ = 0, OE = 0V | $V_{CCA}$ = 1.65V to $V_{CCB}$, $V_{CCB}$ = 2.3V to 5.5V | Full | | | 5.5 | μA |
| Quiescent Supply Current ($I_{CCZB}$) | $V_I$ = $V_{CCI}$ or 0V, $I_O$ = 0, OE = 0V | $V_{CCA}$ = 1.65V to $V_{CCB}$, $V_{CCB}$ = 2.3V to 5.5V | Full | | | 5.5 | μA |
| OE Input Capacitance ($C_I$) | $V_{CCA}$ = 3.3V, $V_{CCB}$ = 3.3V | | +25℃ | | 4 | | pF |
| Input/Output Capacitance A Ports ($C_{IO}$) | $V_{CCA}$ = 3.3V, $V_{CCB}$ = 3.3V | | +25℃ | | 5 | | pF |
| Input/Output Capacitance B Ports ($C_{IO}$) | | | | | 5 | | |

NOTES:

1. $V_{CCI}$ is the $V_{CC}$ associated with the input ports.
2. $V_{CCO}$ is the $V_{CC}$ associated with the output ports.
3. $V_{CCA}$ must be less than or equal to $V_{CCB}$, and $V_{CCA}$ must not exceed 5.5V.

## TIMING REQUIREMENTS

| | | | $V_{CCB}$ = 2.5V | $V_{CCB}$ = 3.3V | $V_{CCB}$ = 5V | UNITS |
|---|---|---|---|---|---|---|
| | | | TYP | TYP | TYP | |
| **($T_A$ = +25℃, $V_{CCA}$ = 1.8V, unless otherwise noted.)** | | | | | | |
| Data Rate | Push-Pull Driving | | 21 | 22 | 24 | Mbps |
| | Open-Drain Driving | | 2 | 2 | 2 | |
| Pulse Duration ($t_W$) | Push-Pull Driving | Data Inputs | 47 | 45 | 41 | ns |
| | Open-Drain Driving | | 500 | 500 | 500 | |
| **($T_A$ = +25℃, $V_{CCA}$ = 2.5V, unless otherwise noted.)** | | | | | | |
| Data Rate | Push-Pull Driving | | 20 | 22 | 24 | Mbps |
| | Open-Drain Driving | | 2 | 2 | 2 | |
| Pulse Duration ($t_W$) | Push-Pull Driving | Data Inputs | 50 | 45 | 41 | ns |
| | Open-Drain Driving | | 500 | 500 | 500 | |
| **($T_A$ = +25℃, $V_{CCA}$ = 3.3V, unless otherwise noted.)** | | | | | | |
| Data Rate | Push-Pull Driving | | | 23 | 24 | Mbps |
| | Open-Drain Driving | | | 2 | 2 | |
| Pulse Duration ($t_W$) | Push-Pull Driving | Data Inputs | | 43 | 41 | ns |
| | Open-Drain Driving | | | 500 | 500 | |
| **($T_A$ = +25℃, $V_{CCA}$ = 5V, unless otherwise noted.)** | | | | | | |
| Data Rate | Push-Pull Driving | | | | 24 | Mbps |
| | Open-Drain Driving | | | | 2 | |
| Pulse Duration ($t_W$) | Push-Pull Driving | Data Inputs | | | 41 | ns |
| | Open-Drain Driving | | | | 500 | |

## SWITCHING CHARACTERISTICS

($T_A$ = +25℃, $V_{CCA}$ = 1.8V, unless otherwise noted. )

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | $V_{CCB}$ = 2.5V | $V_{CCB}$ = 3.3V | $V_{CCB}$ = 5V | UNITS |
|---|---|---|---|---|---|---|---|
| | | | | TYP | TYP | TYP | |
| $t_{PHL}$ | A | B | Push-Pull Driving | 2.4 | 3.0 | 4.3 | ns |
| | | | Open-Drain Driving | 26.0 | 26.3 | 26.7 | |
| $t_{PLH}$ | | | Push-Pull Driving | 4.0 | 3.6 | 3.5 | |
| | | | Open-Drain Driving | 175 | 145 | 110 | |
| $t_{PHL}$ | B | A | Push-Pull Driving | 2.0 | 1.9 | 2.1 | ns |
| | | | Open-Drain Driving | 26.0 | 26.1 | 26.2 | |
| $t_{PLH}$ | | | Push-Pull Driving | 1.7 | 1.5 | 1.4 | |
| | | | Open-Drain Driving | 133 | 69 | 51 | |
| $t_{EN}$ ($t_{PZH}$ & $t_{PZL}$) | OE | A or B | | 24 | 20 | 18 | ns |
| $t_{DIS}$ ($t_{PHZ}$ & $t_{PLZ}$) | OE | A or B | | 1200 | 1200 | 1200 | |
| $t_{rA}$ | A Ports Rise Time | | Push-Pull Driving | 6.6 | 5.8 | 5.4 | ns |
| | | | Open-Drain Driving | 89 | 31 | 10 | |
| $t_{rB}$ | B Ports Rise Time | | Push-Pull Driving | 5.6 | 4.6 | 3.9 | ns |
| | | | Open-Drain Driving | 128 | 98 | 58 | |
| $t_{fA}$ | A Ports Fall Time | | Push-Pull Driving | 2.9 | 2.7 | 2.6 | ns |
| | | | Open-Drain Driving | 1.9 | 1.7 | 1.6 | |
| $t_{fB}$ | B Ports Fall Time | | Push-Pull Driving | 4.6 | 5.9 | 8.0 | ns |
| | | | Open-Drain Driving | 2.2 | 2.3 | 2.9 | |
| $t_{sk(0)}$ | Channel-to-Channel Skew | | | 0.5 | 0.5 | 0.5 | ns |
| Data Rate | | | Push-Pull Driving | 21 | 22 | 24 | Mbps |
| | | | Open-Drain Driving | 2 | 2 | 2 | |

## SWITCHING CHARACTERISTICS

($T_A$ = +25℃, $V_{CCA}$ = 2.5V, unless otherwise noted. )

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | $V_{CCB}$ = 2.5V | $V_{CCB}$ = 3.3V | $V_{CCB}$ = 5V | UNITS |
|---|---|---|---|---|---|---|---|
| | | | | TYP | TYP | TYP | |
| $t_{PHL}$ | A | B | Push-Pull Driving | 2.7 | 3.3 | 4.8 | ns |
| | | | Open-Drain Driving | 26.2 | 26.4 | 26.7 | |
| $t_{PLH}$ | | | Push-Pull Driving | 2.6 | 2.4 | 2.3 | |
| | | | Open-Drain Driving | 169 | 144 | 110 | |
| $t_{PHL}$ | B | A | Push-Pull Driving | 2.4 | 2.3 | 2.4 | ns |
| | | | Open-Drain Driving | 26.3 | 26.4 | 26.5 | |
| $t_{PLH}$ | | | Push-Pull Driving | 2.0 | 1.9 | 1.8 | |
| | | | Open-Drain Driving | 165 | 118 | 55 | |
| $t_{EN}$ ($t_{PZH}$ & $t_{PZL}$) | OE | A or B | | 23 | 19 | 16 | ns |
| $t_{DIS}$ ($t_{PHZ}$ & $t_{PLZ}$) | OE | A or B | | 1200 | 1200 | 1200 | |
| $t_{rA}$ | A Ports Rise Time | | Push-Pull Driving | 3.2 | 2.8 | 2.6 | ns |
| | | | Open-Drain Driving | 120 | 70 | 10 | |
| $t_{rB}$ | B Ports Rise Time | | Push-Pull Driving | 4.5 | 3.4 | 2.6 | ns |
| | | | Open-Drain Driving | 122 | 96 | 62 | |
| $t_{fA}$ | A Ports Fall Time | | Push-Pull Driving | 4.9 | 5.0 | 4.8 | ns |
| | | | Open-Drain Driving | 2.0 | 1.9 | 1.7 | |
| $t_{fB}$ | B Ports Fall Time | | Push-Pull Driving | 4.8 | 6.1 | 8.3 | ns |
| | | | Open-Drain Driving | 1.9 | 2.1 | 2.7 | |
| $t_{sk(0)}$ | Channel-to-Channel Skew | | | 0.5 | 0.5 | 0.5 | ns |
| Data Rate | | | Push-Pull Driving | 20 | 22 | 24 | Mbps |
| | | | Open-Drain Driving | 2 | 2 | 2 | |

## SWITCHING CHARACTERISTICS

($T_A$ = +25℃, $V_{CCA}$ = 3.3V, unless otherwise noted. )

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | $V_{CCB}$ = 3.3V | $V_{CCB}$ = 5V | UNITS |
|---|---|---|---|---|---|---|
| | | | | TYP | TYP | |
| $t_{PHL}$ | A | B | Push-Pull Driving | 3.5 | 4.9 | ns |
| | | | Open-Drain Driving | 26.3 | 26.7 | |
| $t_{PLH}$ | | | Push-Pull Driving | 2.2 | 2.0 | |
| | | | Open-Drain Driving | 133 | 104 | |
| $t_{PHL}$ | B | A | Push-Pull Driving | 3.0 | 3.2 | ns |
| | | | Open-Drain Driving | 26.6 | 26.8 | |
| $t_{PLH}$ | | | Push-Pull Driving | 1.8 | 1.7 | |
| | | | Open-Drain Driving | 132 | 83 | |
| $t_{EN}$ ($t_{PZH}$ & $t_{PZL}$) | OE | A or B | | 18 | 15 | ns |
| $t_{DIS}$ ($t_{PHZ}$ & $t_{PLZ}$) | OE | A or B | | 1200 | 1200 | |
| $t_{rA}$ | A Ports Rise Time | | Push-Pull Driving | 2.2 | 2.0 | ns |
| | | | Open-Drain Driving | 87 | 36 | |
| $t_{rB}$ | B Ports Rise Time | | Push-Pull Driving | 2.9 | 2.3 | ns |
| | | | Open-Drain Driving | 87 | 56 | |
| $t_{fA}$ | A Ports Fall Time | | Push-Pull Driving | 6.2 | 5.8 | ns |
| | | | Open-Drain Driving | 2.3 | 2.0 | |
| $t_{fB}$ | B Ports Fall Time | | Push-Pull Driving | 6.5 | 8.2 | ns |
| | | | Open-Drain Driving | 2.0 | 2.5 | |
| $t_{sk(0)}$ | Channel-to-Channel Skew | | | 0.5 | 0.5 | ns |
| Data Rate | | | Push-Pull Driving | 23 | 24 | Mbps |
| | | | Open-Drain Driving | 2 | 2 | |

## SWITCHING CHARACTERISTICS

($T_A$ = +25℃, $V_{CCA}$ = 5V, unless otherwise noted. )

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | $V_{CCB}$ = 5V | UNITS |
|---|---|---|---|---|---|
| | | | | TYP | |
| $t_{PHL}$ | A | B | Push-Pull Driving | 5.4 | ns |
| | | | Open-Drain Driving | 26.7 | |
| $t_{PLH}$ | | | Push-Pull Driving | 1.9 | |
| | | | Open-Drain Driving | 120 | |
| $t_{PHL}$ | B | A | Push-Pull Driving | 5.6 | ns |
| | | | Open-Drain Driving | 27.3 | |
| $t_{PLH}$ | | | Push-Pull Driving | 1.7 | |
| | | | Open-Drain Driving | 126 | |
| $t_{EN}$ ($t_{PZH}$ & $t_{PZL}$) | OE | A or B | | 16 | ns |
| $t_{DIS}$ ($t_{PHZ}$ & $t_{PLZ}$) | OE | A or B | | 1200 | |
| $t_{rA}$ | A Ports Rise Time | | Push-Pull Driving | 1.8 | ns |
| | | | Open-Drain Driving | 79 | |
| $t_{rB}$ | B Ports Rise Time | | Push-Pull Driving | 2.2 | ns |
| | | | Open-Drain Driving | 73 | |
| $t_{fA}$ | A Ports Fall Time | | Push-Pull Driving | 8.7 | ns |
| | | | Open-Drain Driving | 2.7 | |
| $t_{fB}$ | B Ports Fall Time | | Push-Pull Driving | 8.6 | ns |
| | | | Open-Drain Driving | 2.4 | |
| $t_{sk(0)}$ | Channel-to-Channel Skew | | | 0.5 | ns |
| Data Rate | | | Push-Pull Driving | 24 | Mbps |
| | | | Open-Drain Driving | 2 | |

# APPLICATION INFORMATION

## Applications

The SGM4553 can be used to bridge the digital-switching compatibility gap between two voltage nodes to successfully interface logic threshold levels found in electronic systems. It should be used in a point-to-point topology for interfacing devices or systems operating at different interface voltages with one another. Its primary target application use is for interfacing with open-drain drivers on the data I/Os such as $I^2C$ or 1-wire, where the data is bidirectional and no control signal is available. The SGM4553 can also be used in applications where a push-pull driver is connected to the data I/Os.

## Architecture

The SGM4553 architecture (see Figure 1) is an auto-direction-sensing based translator that does not require a direction-control signal to control the direction of data flow from A to B or from B to A.

These two bidirectional channels independently determine the direction of data flow without a direction-control signal. Each I/O pin can be automatically reconfigured as either an input or an output, which is how this auto-direction feature is realized.

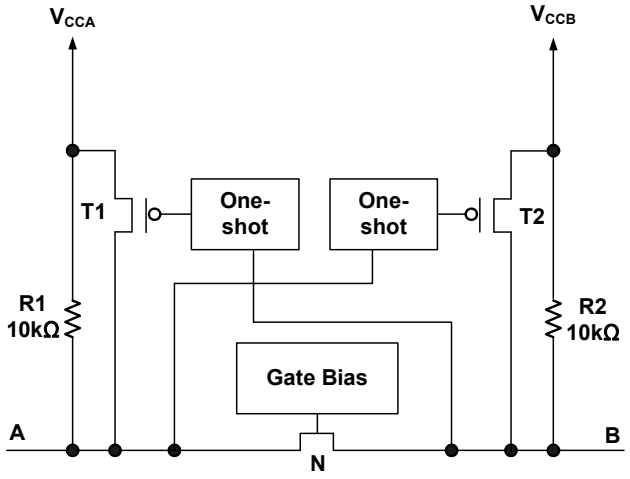



**Figure 1. Architecture of an SGM4553 Cell**

The SGM4553 employs two key circuits to enable this voltage translation:

- An N-channel pass-gate transistor topology that ties the A port to the B port.
- Output one-shot (O.S.) edge-rate accelerator circuitry to detect and accelerate rising edges on the A or B ports.

## Input Driver Requirements

The fall time ($t_{fA}$, $t_{fB}$) of a signal depends on the output impedance of the external device driving the data I/Os of the SGM4553. Similarly, the $t_{PHL}$ and data rates also depend on the output impedance of the external driver. The values for $t_{fA}$, $t_{fB}$, $t_{PHL}$, and data rates in the datasheet assume that the output impedance of the external driver is less than 50Ω.

## Power Up

During operation, ensure that $V_{CCA} \leq V_{CCB}$ at all times. The sequencing of each power supply will not damage the device during the power up operation, so either power supply can be ramped up first.

## Output Load Considerations

We recommend careful PCB layout practices with short PCB trace lengths to avoid excessive capacitive loading and to ensure that proper O.S. triggering takes place. PCB signal trace-lengths should be kept short enough such that the round trip delay of any reflection is less than the one-shot duration. This improves signal integrity by ensuring that any reflection sees a low impedance at the driver. The O.S. circuits have been designed to stay on for approximately 30ns. The maximum capacitance of the lumped load that can be driven also depends directly on the one-shot duration. With very heavy capacitive loads, the one-shot can time-out before the signal is driven fully to the positive rail. The O.S. duration has been set to best optimize trade-offs between dynamic $I_{CC}$, load driving capability, and maximum bit-rate considerations. Both PCB trace length and connectors add to the capacitance that the SGM4553 output sees, so it is recommended that this lumped-load capacitance be considered to avoid O.S. retriggering, bus contention, output signal oscillations, or other adverse system-level affects.

# APPLICATION INFORMATION

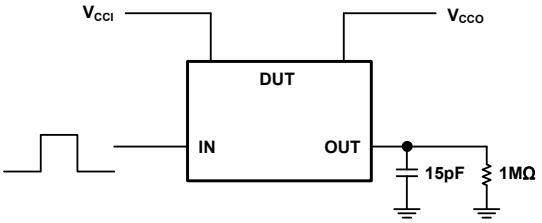
### Enable and Disable

The SGM4553 has an OE input that is used to disable the device by setting OE low, which places all I/Os in the Hi-Z state. OE has an internal pull-down current source, as long as $V_{CCA}$ is powered. The disable time ($t_{DIS}$) indicates the delay between the time when OE goes low and when the outputs are disabled (Hi-Z). The enable time ($t_{EN}$) indicates the amount of time the user must allow for the one-shot circuitry to become operational after OE is taken high.

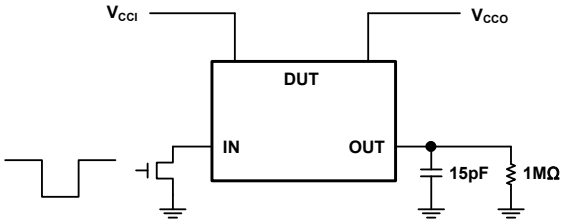
### Pull-Up or Pull-Down Resistors on I/O Lines

Each A port I/O has an internal 10kΩ pull-up resistor to $V_{CCA}$, and each B port I/O has an internal 10kΩ pull-up resistor to $V_{CCB}$. If a smaller value of pull-up resistor is required, an external resistor must be added from the I/O to $V_{CCA}$ or $V_{CCB}$ (in parallel with the internal 10kΩ resistors). Adding lower value pull-up resistors will affect $V_{OL}$ levels, however. The internal pull-ups of the SGM4553 are disabled when the OE pin is low.

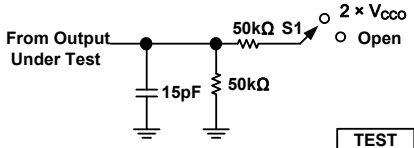
# PARAMETER MEASUREMENT INFORMATION




DATA RATE, PULSE DURATION, PROPAGATION DELAY, OUTPUT RISE AND FALL TIME MEASUREMENT USING A PUSH-PULL DRIVER

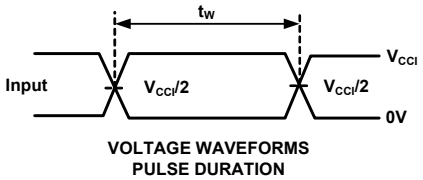



DATA RATE, PULSE DURATION, PROPAGATION DELAY, OUTPUT RISE AND FALL TIME MEASUREMENT USING AN OPEN-DRAIN DRIVER

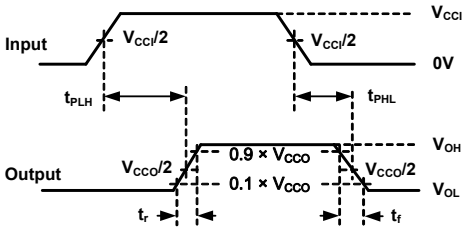



LOAD CIRCUIT FOR ENABLE/DISABLE TIME MEASUREMENT

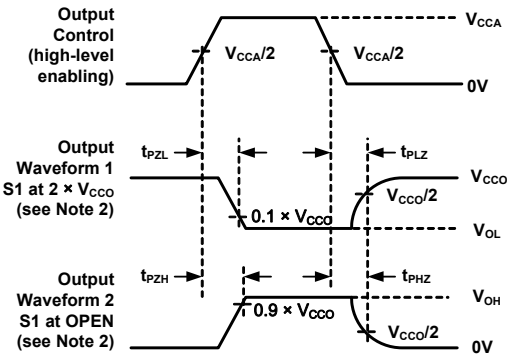
| TEST | S1 |
|---|---|
| $t_{PZL}/t_{PLZ}$ | 2 × $V_{CCO}$ |
| $t_{PHZ}/t_{PZH}$ | Open |




VOLTAGE WAVEFORMS PULSE DURATION




VOLTAGE WAVEFORMS PROPAGATION DELAY TIMES




VOLTAGE WAVEFORMS ENABLE AND DISABLE TIMES

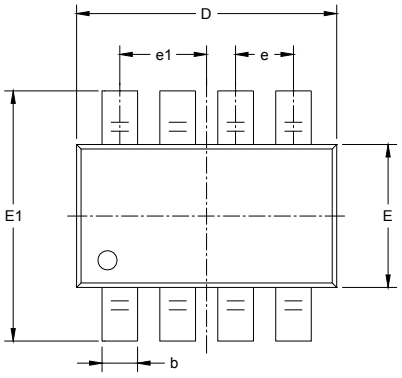
NOTES:

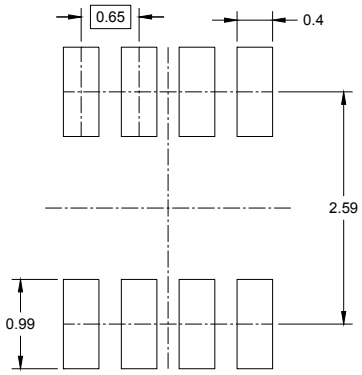
1. $C_L$ includes probe and jig capacitance.
2. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
3. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10MHz, $Z_O$ = 50Ω, dv/dt ≥ 1V/ns.
4. The outputs are measured one at a time, with one transition per measurement.
5. $t_{PLZ}$ and $t_{PHZ}$ are the same as $t_{DIS}$.
6. $t_{PZL}$ and $t_{PZH}$ are the same as $t_{EN}$.
7. $t_{PLH}$ and $t_{PHL}$ are the same as $t_{PD}$.
8. $V_{CCI}$ is the $V_{CC}$ associated with the input ports.
9. $V_{CCO}$ is the $V_{CC}$ associated with the output ports.
10. All parameters and waveforms are not applicable to all devices.

**Figure 2. Load Circuit and Voltage Waveforms**

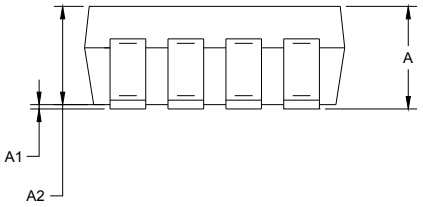
# PACKAGE OUTLINE DIMENSIONS

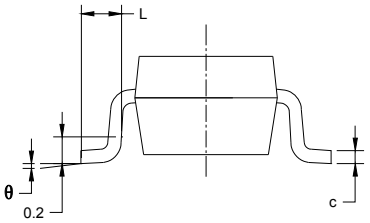
## SOT-23-8




**RECOMMENDED LAND PATTERN** (Unit: mm)

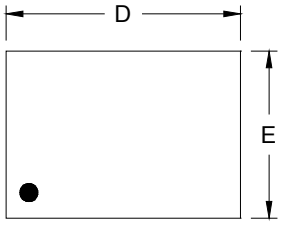


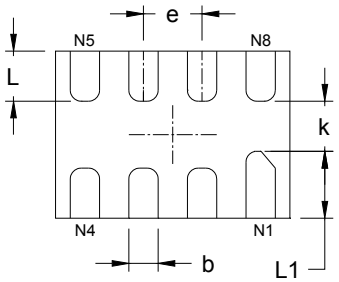

| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 1.050 | 1.250 | 0.041 | 0.049 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 1.050 | 1.150 | 0.041 | 0.045 |
| b | 0.300 | 0.500 | 0.012 | 0.020 |
| c | 0.100 | 0.200 | 0.004 | 0.008 |
| D | 2.820 | 3.020 | 0.111 | 0.119 |
| E | 1.500 | 1.700 | 0.059 | 0.067 |
| E1 | 2.650 | 2.950 | 0.104 | 0.116 |
| e | 0.650 BSC | | 0.026 BSC | |
| e1 | 0.975 BSC | | 0.038 BSC | |
| L | 0.300 | 0.600 | 0.012 | 0.024 |
| θ | 0° | 8° | 0° | 8° |

# PACKAGE OUTLINE DIMENSIONS

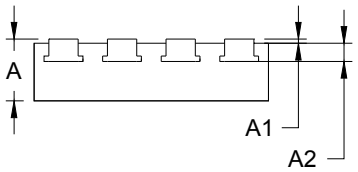
## XTDFN-1.4×1-8L



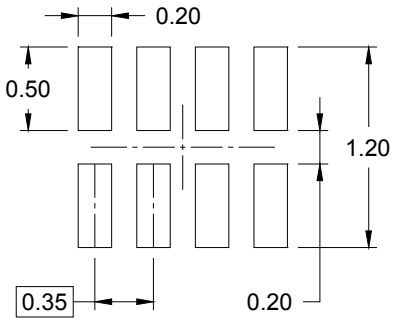

TOP VIEW




BOTTOM VIEW




SIDE VIEW

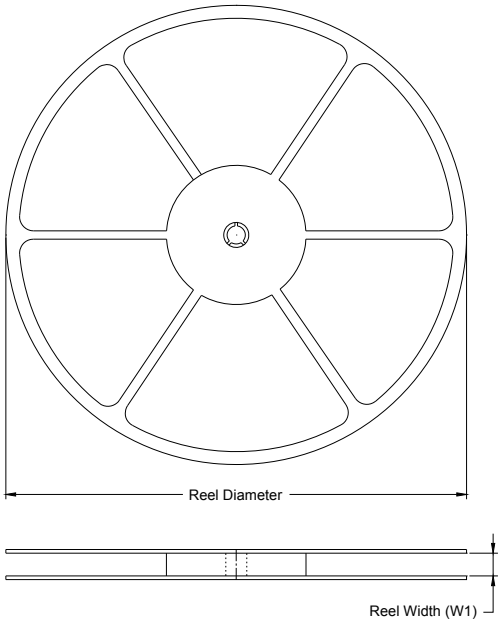



**RECOMMENDED LAND PATTERN** (Unit: mm)

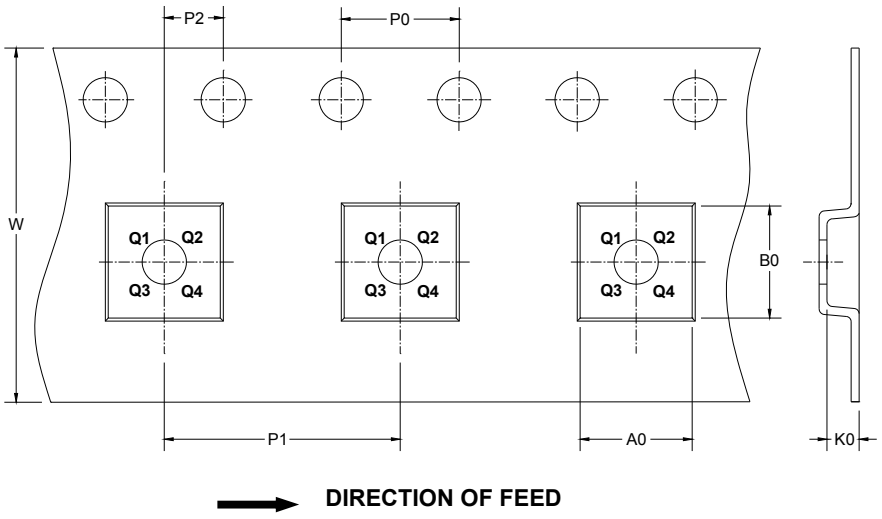
| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 0.340 | 0.400 | 0.013 | 0.016 |
| A1 | 0.000 | 0.050 | 0.000 | 0.002 |
| A2 | 0.110 REF | | 0.004 REF | |
| D | 1.350 | 1.450 | 0.053 | 0.057 |
| E | 0.950 | 1.050 | 0.037 | 0.041 |
| k | 0.200 MIN | | 0.008 MIN | |
| b | 0.150 | 0.200 | 0.006 | 0.008 |
| e | 0.350 TYP | | 0.014 TYP | |
| L | 0.250 | 0.350 | 0.010 | 0.014 |
| L1 | 0.350 | 0.450 | 0.014 | 0.018 |

# TAPE AND REEL INFORMATION

### REEL DIMENSIONS




### TAPE DIMENSIONS

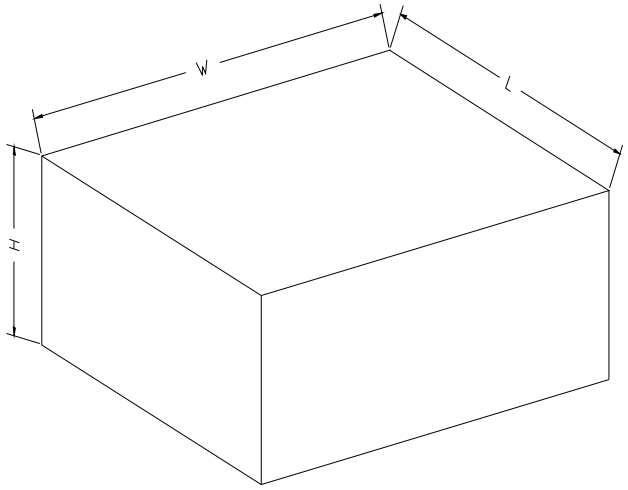



NOTE: The picture is only for reference. Please make the object as the standard.

## KEY PARAMETER LIST OF TAPE AND REEL

| Package Type | Reel Diameter | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P0 (mm) | P1 (mm) | P2 (mm) | W (mm) | Pin1 Quadrant |
|---|---|---|---|---|---|---|---|---|---|---|
| SOT-23-8 | 7″ | 9.5 | 3.17 | 3.23 | 1.37 | 4.0 | 4.0 | 2.0 | 8.0 | Q3 |
| XTDFN-1.4×1-8L | 7″ | 9.5 | 1.15 | 1.6 | 0.5 | 4.0 | 4.0 | 2.0 | 8.0 | Q1 |

## CARTON BOX DIMENSIONS




NOTE: The picture is only for reference. Please make the object as the standard.

## KEY PARAMETER LIST OF CARTON BOX

| Reel Type | Length (mm) | Width (mm) | Height (mm) | Pizza/Carton |
|---|---|---|---|---|
| 7″ (Option) | 368 | 227 | 224 | 8 |
| 7″ | 442 | 410 | 224 | 18 |

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