FEDL9225B-03

OKI Semiconductor

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MSM9225B

CAN (Controller Area Network) Controller

GENERAL DESCRIPTION

The MSM9225B is a microcontroller peripheral LSI which conforms to the CAN protocol for high-speed LANs in automobiles.

FEATURES

- Conforms to CAN protocol specification (Bosch, V2.0 part B/Active)
- Maximum of 1 Mbps bit rate
- Communication method:
  - Transmission line is bi-directional, two-wire serial communication
  - NRZ (Non-Return to Zero) system using bit stuff function
  - Multi-master system
  - Broadcast system
- Message boxes:
  - Up to 16 message boxes can be used, and messages up to 8 bytes long can be transmitted or received for each message box.
  - Number of received messages can be extended by group message function (up to 2 groups can be set)
  - Overwrite flag is provided
- Priority control by identifier
  - 2032 types in standard format, 2032×2^{18} types in extended format
- Microcontroller interface
  - Corresponding to both parallel and serial interface
    - Parallel interface: Separate address/data bus type (with address latch signal/no address latch signal) and multiplexed address/data bus type
    - Serial interface: Synchronous communication type
  - Three interrupt sources: Transmission/receive/error
- Error control:
  - Bit error/stuff error/CRC error/form error/acknowledgment error detection functions
  - Retransmission/error status monitoring function when error occurs
  - Bit error flag/stuff error flag/CRC error flag/form error flag/acknowledge error flag are provided
- Communication control by remote data request function
- Sleep/Stop mode function
- Supply voltage: 5 V±10%
- Operating temperature: –40 to +125°C
- Package: 44-pin plastic QFP (QFP44-P-910-0.80-2K) (Product name: MSM9225BGA-2K)

BLOCK DIAGRAM

CONFIGURATION EXAMPLE

PIN CONFIGURATION

44-Pin Plastic QFP (Top View)

PIN DESCRIPTIONS

Symbol	Pin	Type	Description
$\overline{CS}$	10	I	Chip select pin. When "L", PALE, $\overline{PWR}$, $\overline{PRD}$/SR$\overline{W}$, SCLK and SDO pins (microcontroller interface pins) are valid. When "H", these pins are invalid.
A7-0	41-44, 1-4	I	Address bus pins (when using separate buses). If used with a multiplexed bus or if used in the serial mode, fix these pins at "H" or "L" levels.
AD7-0/ D7-0	31-38	I/O	Multiplexed bus: Address/data pins (AD7-0) Separate buses: Data pins (D7-0) If used in the serial mode, fix these pins at a "L" levels.
$\overline{PWR}$	26	I	Write input pin if used in the parallel mode. Data is captured when this pin is at a "L" level. If used in the serial mode, fix this pin at a "L" level.
$\overline{PRD}$/ SR$\overline{W}$	9	I	Parallel mode: Read signal pin ($\overline{PRD}$) When at a "L" level, data is output from the data pins. Serial mode: Read/write signal pin (SR$\overline{W}$) When at a "H" level, data is output from the SDO pin. When at a "L" level, the SDO pin is at high impedance, and data is captured beginning with the second byte of data input from the SDI pin.
PALE	27	I	Address latch signal pin When at a "H" level, addresses are captured. If used in the parallel mode and the address latch signal is unnecessary or in the serial mode, fix this pin at a "H" or "L" level.
SDI	7	I	Serial data input pin Addresses (1st byte) and data (beginning from the 2nd byte) are input to this pin, LSB first. If used in the parallel mode, fix this pin at a "H" or "L" level.
SDO	5	O	Serial data output pin When the $\overline{CS}$ pin is at a "H" level, this pin is at high impedance. When $\overline{CS}$ is at a "L" level, data is output from this pin, LSB first. If used in the parallel mode, fix this pin at a "H" or "L" level.
SCLK	8	I	Shift clock input pin for serial data At the rising edge of the shift clock, SDI pin data is captured. At the falling edge, data is output from the SDO pin.
$\overline{PRDY}$/ SWAIT	16	O	Ready output pin When required by the MSM9225B, a signal may be output to extend the bus cycle until the internal access is completed. Parallel mode ($\overline{PRDY}$): "L" level output — Internal access in progress; High impedance output — After completion of access Serial mode (SWAIT): "H" level output — Internal access in progress; "L" level output — After completion of access

<table>
<tr><th>Symbol</th><th>Pin</th><th>Type</th><th>Description</th></tr>
<tr><td>Mode1, 0</td><td>29, 30</td><td>I</td><td>Microcontroller interface select pins
<table>
<tr><th>Mode1</th><th>Mode0</th><th colspan="3">Interface</th></tr>
<tr><td>0</td><td>0</td><td rowspan="3">Parallel mode</td><td rowspan="2">Separate buses</td><td>No address latch signal</td></tr>
<tr><td>0</td><td>1</td><td>With address latch signal</td></tr>
<tr><td>1</td><td>0</td><td colspan="2">Multiplexed buses</td></tr>
<tr><td>1</td><td>1</td><td colspan="3">Serial mode</td></tr>
</table></td></tr>
<tr><td>$\overline{\text{INT}}$</td><td>11</td><td>O</td><td>Interrupt request output pin
When an interrupt request occurs, a “L” level is output. This pin automatically outputs a “H” level after 32 Ts (T = 1/fosc).
Three types of interrupts share this pin: transmission complete, reception complete, and error.</td></tr>
<tr><td>$\overline{\text{RESET}}$</td><td>25</td><td>I</td><td>Reset pin
System is reset when this pin is at a “L” level.</td></tr>
<tr><td>XT</td><td>13</td><td>I</td><td rowspan="2">Clock pins. If internal oscillator is used, connect a crystal (ceramic resonator).
If external clock is used, input clock via XT pin. The $\overline{\text{XT}}$ pin should be left open.</td></tr>
<tr><td>$\overline{\text{XT}}$</td><td>14</td><td>O</td></tr>
<tr><td>Rx0, Rx1</td><td>18, 19</td><td>I</td><td>Receive input pin. Differential amplifier included.</td></tr>
<tr><td>Tx0, Tx1</td><td>22, 23</td><td>O</td><td>Transmission output pin</td></tr>
<tr><td>V_{DD}</td><td>12, 20, 24, 40</td><td>—</td><td>Power supply pin</td></tr>
<tr><td>GND</td><td>6, 15, 17, 21, 28, 39</td><td>—</td><td>GND pin</td></tr>
</table>

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Condition	Rating	Unit
Power Supply Voltage	V_{DD}	Ta = 25°C	–0.3 to +7.0	V
Input Voltage	V_I	—	–0.3 to V_{DD} +3.0	V
Output Voltage	V_O	—	–0.3 to V_{DD} +3.0	V
Power Dissipation	P_D	Ta ≤ 25°C	615	mW
Operating Temperature	T_{OP}	—	–40 to +125	°C
Storage Temperature	T_{STG}	—	–65 to +150	°C

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Power Supply Voltage	V_{DD}	$V_{DD} = AV_{DD}$	4.5	5.0	5.5	V
Operating Temperature	T_{OP}	—	–40	+25	+125	°C

ELECTRICAL CHARACTERISTICS

DC Characteristics

(V_{DD} = 4.5 to 5.5 V, Ta = –40 to +125°C)

Parameter	Symbol	Applicable pin	Condition	Min.	Max.	Unit
"H" Input Voltage	V_{IH}	Applies to all inputs	—	$0.8V_{DD}$	V_{DD} +0.3	V
"L" Input Voltage	V_{IL}	Applies to all inputs	—	–0.3	+0.2 V_{DD}	V
"H" Input Current	I_{IH1}	XT	$V_I = V_{DD}$	3	25	µA
	I_{IH2}	Other inputs		–1.0	+1.0	µA
"L" Input Current	I_{IL1}	XT	V_I = 0V	–25	–3	µA
	I_{IL2}	Other input		–1.0	+1.0	µA
"H" Output Voltage	V_{OH1}	$\overline{INT}$, $\overline{PRDY}$/SWAIT	I_{OH1} = –80 µA	V_{DD} –1.0	—	V
	V_{OH2}	AD7-0/D7-0	I_{OH2} = –400 µA	V_{DD} –1.0	—	V
"L" Output Voltage	V_{OL1}	$\overline{INT}$, $\overline{PRDY}$/SWAIT	I_{OL1} = 1.6 mA	—	0.4	V
	V_{OL2}	AD7-0/D7-0	I_{OL2} = 3.2 mA	—	0.4	V
Output Leakage Current	I_{IH1}	$\overline{PRDY}$/SWAIT AD7-0/D7-0	$V_I = V_{DD}$/0 V	–1.0	+1.0	µA
Dynamic Supply Current	I_{DD}	—	f_{OSC} = 16 MHz, No Load	—	9	mA
Static Supply Current	I_{DDS}	—	SLEEP Mode	—	400	µA
		—	STOP Mode	—	100	µA

Rx0, Rx1 Characteristics

Differencial input mode

(V_{DD} = 4.5 to 5.5 V, Ta = –40 to +125°C)

Parameter	Symbol	Applicable pin	Condition	Min.	Max.	Unit
'dominant' Input Voltage	VRx0 (d)	Rx0	VRx1 = 0.4 V_{DD} to 0.6 V_{DD}	–0.3	VRx1 –0.4	V
'recessive Input Voltage	VRx0 (r)	Rx0		VRx1 +0.4	V_{DD} +3	V
Input Leakage Current	I_{LK}	Rx0, Rx1	$VR_{X1} = V_{DD}$/0 V	–1	+1	µA

Tx0, Tx1 Characteristics

(V_{DD} = 4.5 to 5.5 V, Ta = –40 to +125°C)

Parameter	Symbol	Condition	Min.	Max.	Unit
"H" Output Voltage	V_{OH}	I_{OH} = –3.0 mA	V_{DD} –0.4	—	V
"L" Output Voltage	V_{OL}	I_{OL} = 10.0 mA	—	0.4	V

AC Characteristics

Parallel mode

(V_{DD} = 4.5 to 5.5 V, Ta = –40 to +125°C, f_{OSC} = 16 MHz)

Parameter		Symbol	Condition	Min.	Max.	Unit
ALE Address Setup Time		t_{AS}	—	10	—	ns
ALE Address Hold Time		t_{AH}	—	10	—	ns
$\overline{PRD}$ Output Data Delay Time		t_{RDLY}	—	—	60*1	ns
$\overline{PRD}$ Output Data Hold Time		t_{RDH}	—	5	—	ns
ALE "H" Level Width		t_{WALEH}	—	16.5	—	ns
Access Cycle	When $\overline{PRDY}$ is not generated	t_{cyc}	—	4T	—	ns
	When $\overline{PRDY}$ is generated			7T	—	ns
Address Hold Time from $\overline{PRD}$		t_{RAH}	—	0	—	ns
ALE Delay Time from $\overline{PRD}$		t_{HRA}	—	27	—	ns
$\overline{PRD}$ "H" Level Width		t_{WRDH}	—	27	—	ns
$\overline{PRDY}$ "L" Delay Time		t_{ARLDLY}	—	—	35	ns
$\overline{PRDY}$ "L" Level Width		t_{WRDYL}	—	0	2.5T	ns
Data Output Delay Time from $\overline{PRDY}$		t_{ARDDLY}	—	—	35	ns
$\overline{PWR}$ Hold Time from $\overline{PRDY}$		t_{ARWDLY}	—	10	—	ns
Input Data Setup Time		t_{WDS}	—	30	—	ns
Input Data Hold Time		t_{WDH}	—	4	—	ns
$\overline{PRD}$ Delay Time		t_{RS}	—	10	—	ns
$\overline{PWR}$ Delay Time		t_{WS}	—	10	—	ns
Address Hold Time from $\overline{PWR}$		t_{WAH}	—	10	—	ns
ALE Delay Time from $\overline{PWR}$		t_{HWA}	—	27	—	ns
$\overline{PWR}$ "H" Level Width		t_{WRH}	—	40	—	ns
$\overline{PWR}$ "L" Level Width		t_{WRL}	—	20*1	—	ns
$\overline{CS}$ Delay Time from $\overline{PRD}$		t_{HRC}	—	0	—	ns
$\overline{CS}$ Delay Time from $\overline{PWR}$		t_{HWC}	—	0	—	ns

T = $1/f_{OSC}$

The values with *1 indicate those when $\overline{PRDY}$ is not generated.

The values with *1 when $\overline{PRDY}$ is generated are defined by "Data Output Delay Time from $\overline{PRDY}$" t_{ARDDLY} and "$\overline{PWR}$ Hold Time from $\overline{PRDY}$" t_{ARWDLY}.

Serial mode

(V_{DD} = 4.5 to 5.5 V, Ta = –40 to +125°C, f_{OSC} = 16 MHz)

Parameter	Symbol	Condition	Min.	Max.	Unit
$\overline{CS}$ Setup Time	t_{CS}	—	10	—	ns
$\overline{CS}$ Hold Time	t_{CH}	—	8T	—	ns
SCLK Cycle	t_{CP}	—	167	—	ns
SCLK Pulse Width	t_{CW}	—	83	—	ns
SDI Setup Time	t_{DS}	—	30	—	ns
SDI Hold Time	t_{DH}	—	5	—	ns
SDO Output Enable Time	t_{CSODLY}	—	—	30	ns
SDO Output Disable Time	t_{CSZDLY}	—	—	30	ns
SDO Output Delay Time	t_{PD}	—	—	30	ns
SR$\overline{W}$ Setup Time	t_{RS}	—	10	—	ns
SR$\overline{W}$ Hold Time	t_{RH}	—	0	—	ns
SWAIT Output Delay Time	t_{SRDLY}	—	—	2T	ns
SWAIT “H” Level Width	t_{WRDY}	—	—	6T	ns
Byte Delay	t_{WAIT}	—	8T	—	ns

T = 1/f_{OSC}

Other timing characteristics

(V_{DD} = 4.5 to 5.5 V, Ta = –40 to +125°C)

Parameter	Symbol	Condition	Min.	Max.	Unit
System Clock Cycle	t_{clkcy}	—	62	—	ns
$\overline{RESET}$ “H” Level Input Width	t_{WRSTH}	—	5	—	µs
$\overline{RESET}$ “L” Level Input Width	t_{WRSTL}	—	5	—	µs
$\overline{INT}$ “L” Level Output Width	t_{WINTL}	—	32T	—	ns

T = 1/f_{OSC}

TIMING DIAGRAMS

Separate Bus Mode

Read access timing

Note: The $\overline{PRDY}$ signal may be output depending on the internal state of the MSM9225B.

Write access timing

Note: The $\overline{PRDY}$ signal may be output depending on the internal state of the MSM9225B.

Separate Bus/Address Latch Mode

Read access timing

Note: The $\overline{\text{PRDY}}$ signal may be output depending on the internal state of the MSM9225B.

Write access timing

Note: The $\overline{\text{PRDY}}$ signal may be output depending on the internal state of the MSM9225B.

Multiplexed Bus Mode

Read access timing

Note: The $\overline{\text{PRDY}}$ signal may be output depending on the internal state of the MSM9225B.

Write access timing

Note: The $\overline{\text{PRDY}}$ signal may be output depending on the internal state of the MSM9225B.

Serial Mode

Read access timing

Note: The SWAIT signal will be output during the interval between address and data transfers.

Write access timing

Note: The SWAIT signal will be output during the interval between address and data transfers.
* : don't care

Other Timing

PACKAGE DIMENSIONS

(Unit: mm)

QFP44-P-910-0.80-2K

Package material	Epoxy resin
Lead frame material	42 alloy
Pin treatment	Solder plating (≥5μm)
Package weight (g)	0.41 TYP.
Rev. No./Last Revised	4/Nov. 28, 1996

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Notes for Mounting the Surface Mount Type Package

The surface mount type packages are very susceptible to heat in reflow mounting and humidity absorbed in storage. Therefore, before you perform reflow mounting, contact Oki's responsible sales person on the product name, package name, pin number, package code and desired mounting conditions (reflow method, temperature and times).

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