DM7052  SFP+ 100/1000/2.5/5/10G Transceiver

KEY FEATURES:

- Supports 10GBase-T Links up to 30m using Cat6a Cable
- Supports 10/100/1000/2.5/5G – up to 100m Using Cat5e or better
- SFF-8431 and SFF-8432 MSA Compliant
- NBase-T Compliant
- Low Power Consumption
  - (2.1W MAX, 1.75W TYP, 30m @ 10G)
  - (1.9W MAX, 1.65W TYP, 100m @ 5G)
  - (1.7W MAX, 1.35W TYP, 100m @ 2.5G)
- Fast Retrain EMI Cancellation Algorithm
- Low EMI Emissions
- I2C 2 Wire Serial Interface for Serial Id and Phy Registers
- Auto-negotiates with other NBase-T PHYs
- MDI/MDIX Crossover
- Multiple Loopback Modes for Testing and Troubleshooting
- Built-in Cable Monitoring and Link Diagnostic Features
  - Cable Length Measurements
  - Opens/Shorts
- Robust Die Cast Housing
- Bail Latch Style ejector mechanism
- Unshielded and Shielded cable support

Product Overview:
The DM7052 copper transceiver module is a high performance integrated duplex data link for bi-directional communication over copper cable. The DM7052 SFP+ module is compliant with the IEEE 802.3bz standard. It is specifically designed for high speed communication links that require 10G over Cat6a cable or 2.5/5G over Cat 5e cable.
Figure 1: Block Diagram
Figure 2: Mechanical Dimensions
### Table 1: SFP+ Module Electrical Pin Definition

<table>
<thead>
<tr>
<th>Pin</th>
<th>Logic</th>
<th>Symbol</th>
<th>Name/Description</th>
<th>Plug Sequence</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VeeT</td>
<td></td>
<td>Transmitter Ground</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>LVTTL-O</td>
<td>Tx Fault</td>
<td>Transmitter Fault</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>LVTTL-I</td>
<td>Tx Disable</td>
<td>Transmitter Disable –</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>LVTTL-I/O</td>
<td>SDA</td>
<td>2-wire Serial Interface Data Line</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>LVTTL-I/O</td>
<td>SCL</td>
<td>2-wire Serial Interface Clock</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Mod_ABS</td>
<td></td>
<td>Module Absent, connect to VeeT or VeeR in the module</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>LVTTL-I</td>
<td>RS0</td>
<td>Rate Select 0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>LVTTL-O</td>
<td>Rx LOS</td>
<td>Receiver Loss of Signal Indication</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>LVTTL-I</td>
<td>RS1</td>
<td>Rate Select 1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>VeeR</td>
<td></td>
<td>Receiver Ground</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>VeeR</td>
<td></td>
<td>Receiver Ground</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>CML-O</td>
<td>RD-</td>
<td>Receiver Inverted Data Output</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>CML-O</td>
<td>RD+</td>
<td>Receiver Non-Inverted Data Output</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>VeeR</td>
<td></td>
<td>Receiver Ground</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>15</td>
<td>VeeR</td>
<td></td>
<td>Receiver 3.3V Supply</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>VeeT</td>
<td></td>
<td>Transmitter 3.3V Supply</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>VeeT</td>
<td></td>
<td>Transmitter Ground</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>18</td>
<td>CML-I</td>
<td>TD+</td>
<td>Receiver Inverted Data Output</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>CML-I</td>
<td>TD-</td>
<td>Transmitter Inverted Data Input</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>VeeT</td>
<td></td>
<td>Module Transmitter Ground</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Note 1: The module signal grounds should be isolated from the module case.

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**Mating of SFP Transceiver to SFP Host Board Connector**

The pads on the PCB of the SFP transceiver shall be designed for a sequenced mating as follows:

- **First mate:** Ground contacts
- **Second mate:** Power contacts
- **Third mate:** Signal contacts

The SFP MSA specification for a typical contact pad plating for the PCB is 0.38 micrometers minimum hard gold over 1.27 micrometers minimum thick nickel. To ensure the long term reliability performance after a minimum of 50 insertion removal cycles, the contact plating of the transceiver is 0.762 micron (30 microinches) over 3.81 micron (150 microinches) of Ni on Cu contact pads.

**RJ45 Connector**

RJ45 connector shall support shielded and unshielded cables. Also, the connector is mechanically robust enough and designed to prevent loss of link, when the cable is positioned or moves in different angles. The connector shall pass the “wiggle” RJ45 connector operational stress test. During the test, after the cable is plugged in, the cable is moved in circle to cover all 360 deg in the vertical plane, while the data traffic is on. There shall be no link or data loss.
Latch Requirements
The SFP transceiver latch should be mechanically robust and designed to prevent unintentional unlatching during insertion or extraction of the transceiver cable. The transceiver is designed with a "Bail type ejector latch mechanism" that allows the SFP module to be easily released from the cage, when the adjacent SFP ports in both rows are also populated and regardless of whether the SFP module is placed in the lower or upper row. The latch shall also pass the "wiggle” RJ45 connector stress test.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Units</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>SFP transceiver insertion</td>
<td>N/A</td>
<td>18</td>
<td>Newtons</td>
<td>Measure without the force from any cage kick out springs. Module to be inserted into nominal cage.</td>
</tr>
<tr>
<td>SFP transceiver extraction</td>
<td>N/A</td>
<td>12.5</td>
<td>Newtons</td>
<td>Measure without the force from any cage kick out springs. Module to be inserted into nominal cage.</td>
</tr>
<tr>
<td>SFP transceiver retention</td>
<td>90</td>
<td>170</td>
<td>Newtons</td>
<td>No functional damage to module below 90N.</td>
</tr>
<tr>
<td>Insertion/removal cycles, SFP transceiver</td>
<td>50</td>
<td>N/A</td>
<td>Cycles</td>
<td>No functional damage to module, cage or connector</td>
</tr>
</tbody>
</table>

Table 2 Insertion, Extraction and Retention Forces for SFP Transceivers

Regulatory Requirements
The SFP transceiver installed into the host system requires meeting Compliance Requirements listed in this paragraph.

In order to achieve this, the module must be evaluated in considering its use in the equipment designs. Unless otherwise specified, the transceiver module shall meet the current version, at the time of manufacturing, of the applicable EMI/EMC specifications for telecommunication network and information technology/multimedia equipment.

Radiated Emission (RE)

The DM7052 CuSFP transceiver shall meet the applicable FCC Part 15 emission requirements.

DM7052 CuSFP transceiver minimum emission requirements are:

- **Class B** radiated emission requirements by using **shielded** cables at least 4dB margin.

10.0 KHz – 18.0 GHz is recommended frequency range for radiated emission testing.

Electrostatic Discharge (ESD)

In addition the the CuSFP module or host platform shall not show susceptibility to conducted immunity when applied to the interface cable per the requirements of IEC 61000-4-2:

- Contact ESD only to the accessible portions of the module (i.e. front panel connector receptacle). 8 kV - Air Discharge and 4 kV – Contact discharge.
  - **Criteria B** (see paragraph 6.7 for Criteria’s definition) should be used as a measurable effect from ESD applied (25 discharges by polarity – both air/contact) to the system used with CuSFP modules

Traffic generation and Susceptibility criteria.

Traffic generation and monitoring.
A minimum 50% utilization will should be established for preliminary investigation when possible, with final evaluation being performed with a worst-case utilization.

Susceptibility Criteria:
The disturbances will be applied to the system as a whole. Data losses will be reported according to the following:

Performance Criteria:
Performance Criteria A
During the test and after the test, system with CuSFP module shall continue to operate:
- without degradation resulting in no greater than 1% of packets per second dropped,
- with zero requests for retry, beyond requests resulting from the 1% per second allowable data loss
- with no degradation in the data transmission rate, beyond requests resulting from the 1% per second allowable data loss
- without protocol failure
- without loss of link
- without alarm signaling triggered.

Monitoring Method:
The Traffic Generator will be monitored. The link, speed, retry rates, etc, status during the test will be reviewed by equipment status logs after the test, and monitored by LED observation during the test.

Performance Criteria B
Error rate, request for retry and speed of data transmission rate may be degraded during the application of the test. Degradation of the performance as described in criteria A is permitted provided that the normal operation of the EUT is self-recoverable to the condition immediately before the application of the test. In these cases, operator response is not permitted to re-initiate an operation.

Monitoring Method:
The Traffic Generator will be monitored. The link, speed, retry rates, etc, status during the test will be reviewed by equipment status logs after the test, and monitored by LED observation during the test.

Performance Criteria C
Degradation of the performance as described in criteria A is permitted provided that the normal operation of the EUT is self-recoverable to the condition immediately before the application of the test or can be restored after the test by the operator.

Monitoring Method:
The Traffic Generator will be monitored. The link, speed, retry rates, etc, status during the test will be reviewed by equipment status logs after the test, and monitored by LED observation during the test.

Flammability
The PCB of the SFP module shall be min. V-0 UL flame rated. Applicable standards: UL/CSA 60950 and IEC 60950.
Environmental and Quality Requirements

Accelerated Aging

The SFP+ transceiver module shall be subjected to an accelerated aging test that exposes the module to 85°C case temperature while being powered at 3.3V for 2000 hours.

Failure criteria: The product is considered to have failed this test if any of the following occurred:
1. Failure of test unit to perform ping or traffic test;
2. Excessive corrosion of components.

Relative Humidity (Non-Operational)

The SFP+ transceiver module shall be subjected to the temperature and humidity profile as per MIL STD 202G Method 103B,
- Test description: The module shall be subjected to the temperature and humidity profile of 85°C/85% RH for 1000 hours. The product shall be non-operational during this entire period.
- Failure criteria: The product is considered to have failed this test if any of the following occurred:
  1. Failure of test unit to perform ping or traffic test;
  2. Excessive corrosion of components.

Shock and Vibration

- 16 2.5/5G NBase-T SFP+ copper transceivers shall be subject to mechanical shock test and vibration test.
- Mechanical shock test
  The mechanical shock test shall use the following specification:
  A half-sine wave shock shall be applied on the DUT, 5 times per direction for 6 directions.
  Peak acceleration of the input 1500G. Pulse width of half-sine wave 0.5ms.
- Vibration test
  The vibration test shall use the following specification:
  A random vibration input for a period of 4 min per cycle, 4 cycle per axis.
  The input acceleration level shall be 20G over the frequency band of 20 to 2000 Hz.

- Failure criteria: The product is considered to have failed this test if any of the following occurred:
  1. Failure of test unit to perform ping or traffic test;
  2. Excessive corrosion of components.

Temperature Cycling

Thirty-two Modules shall be place in a temperature cycling chamber (16 operational and 16 non-operational). The temperature extremes shall be -5°C to +85°C. The dwell time at each temperature extreme shall be 10 minutes. The transition time between each temperature extreme shall be 8 minutes. 100 thermal cycles shall be complete. There shall be no evidence of any electrical or physical degradation to the samples, as a result of the thermal cycling.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min</th>
<th>Max</th>
<th>Units</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Temperature</td>
<td>Ts</td>
<td>-40</td>
<td>85</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Case Operating Temperature</td>
<td>Tc</td>
<td>-5</td>
<td>85</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>RH</td>
<td>5</td>
<td>95</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Supply Voltage (3.3V)</td>
<td>Vcc</td>
<td></td>
<td>3.6</td>
<td>VDC</td>
<td></td>
</tr>
<tr>
<td>Low Speed Input Voltage</td>
<td></td>
<td>-0.5</td>
<td>Vcc+0.3</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Two-Wire Interface Input Voltage</td>
<td></td>
<td>-0.3</td>
<td>Vcc+0.5</td>
<td>V</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Module Specifications: Absolute Maximum Operating Conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Typ</th>
<th>Units</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Case Temperature</td>
<td>Tc</td>
<td>0</td>
<td>3.135</td>
<td>3.3</td>
<td>3.465</td>
<td>VDC</td>
<td></td>
</tr>
<tr>
<td>Supply Voltage (3.3V)</td>
<td>Vcc</td>
<td></td>
<td>3.135</td>
<td></td>
<td>3.465</td>
<td>VDC</td>
<td></td>
</tr>
<tr>
<td>Power (30m @ 25C ambient, 10Gbps)</td>
<td></td>
<td>2.1</td>
<td>1.75</td>
<td>1.75</td>
<td></td>
<td>W</td>
<td>Using Cat6a Cable</td>
</tr>
<tr>
<td>Power (100m @ 25C ambient, 5Gbps)</td>
<td></td>
<td>1.9</td>
<td>1.65</td>
<td>1.65</td>
<td></td>
<td>W</td>
<td>Using Cat5e Cable</td>
</tr>
<tr>
<td>Power (100m @ 25C ambient, 2.5Gbps)</td>
<td></td>
<td>1.7</td>
<td>1.35</td>
<td>1.35</td>
<td></td>
<td>W</td>
<td>Using Cat5e Cable</td>
</tr>
</tbody>
</table>

Table 4: Module Specifications: Recommended Operating Conditions
The module identification is located in the EEPROM, which is accessed over the 2-wire serial management interface. The address of the EEPROM is 0xA0 (1010000X). The following table shows the SFP+ EEPROM memory map and the actual data.

<table>
<thead>
<tr>
<th>Data Address</th>
<th>Field Size</th>
<th>Field Name</th>
<th>Field Description</th>
<th>Field Value</th>
<th>Value Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>Identifier</td>
<td>Type of transceiver</td>
<td>03</td>
<td>SFP TRANSCEIVER</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Ext. Identifier</td>
<td>Extended identifier of type of serial transceiver</td>
<td>04</td>
<td>WITH SERIAL ID</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Connector</td>
<td>Code for connector type</td>
<td>22</td>
<td>RJ45 Connector</td>
</tr>
<tr>
<td>3-10</td>
<td>8</td>
<td>Transceiver</td>
<td>Code for electronic or optical compatibility</td>
<td>00,00,00,00, 00,00,00,00</td>
<td>2.5/5G NBase-T is Undefined in SFF-8472</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>Encoding</td>
<td>Code for serial encoding algorithm</td>
<td>00</td>
<td>UNSPECIFIED</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>BR, Nominal</td>
<td>Nominal signaling rate, units of 100Mbits/sec</td>
<td>64</td>
<td>Up to 10Gb Bit Rate</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>Rate Identifier</td>
<td>Type of rate select functionality</td>
<td>00</td>
<td>UNSPECIFIED</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>Length (SMF, km)</td>
<td>Link length supported for single mode fiber, units of km</td>
<td>00</td>
<td>NA</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>Length (SMF)</td>
<td>Link length supported for single mode fiber, units of 100m</td>
<td>00</td>
<td>NA</td>
</tr>
<tr>
<td>16</td>
<td>1</td>
<td>Length (50µm)</td>
<td>Link length supported for 50µm OM2 fiber, units of 10m</td>
<td>00</td>
<td>NA</td>
</tr>
<tr>
<td>17</td>
<td>1</td>
<td>Length (62.5µm)</td>
<td>Link length supported for 62.5µm OM1 fiber, units of 10m</td>
<td>00</td>
<td>NA</td>
</tr>
<tr>
<td>18</td>
<td>1</td>
<td>Length (cable)</td>
<td>Link length supported for copper or direct attach cable, units of m</td>
<td>64</td>
<td>Up to 100m</td>
</tr>
<tr>
<td>19</td>
<td>1</td>
<td>Length (OM3)</td>
<td>Link length supported for 50µm OM3 fiber, units of 10m</td>
<td>00</td>
<td>RESERVED</td>
</tr>
<tr>
<td>20-35</td>
<td>16</td>
<td>Vendor name</td>
<td>SFP vendor name (ASCII)</td>
<td>4D,65,74,68, 6F,64,65,20, 45,6C,65,63, 2E,20,20,20</td>
<td>Methode Elec (ASCII)</td>
</tr>
<tr>
<td>36</td>
<td>1</td>
<td>Transceiver</td>
<td>Code for electronic or optical compatibility</td>
<td>01</td>
<td>UNALLOCATED</td>
</tr>
<tr>
<td>37-39</td>
<td>3</td>
<td>Vendor OUI</td>
<td>SFP transceiver vendor IEEE company ID</td>
<td>00,17,05</td>
<td>Methode OUI</td>
</tr>
<tr>
<td>40-55</td>
<td>16</td>
<td>Vendor PN</td>
<td>Part number provided by SFP transceiver vendor (ASCII)</td>
<td>44,4D,37,30, 35,32,20,20, 20,20,20,20, 20,20,20</td>
<td>DM7052 (ASCII)</td>
</tr>
<tr>
<td>56-59</td>
<td>4</td>
<td>Vendor rev</td>
<td>Revision level for part number provided by vendor (ASCII)</td>
<td>2D,20,31,31</td>
<td>56: Part Rev &quot;~&quot; 57: Reserved 58: FPGA FW &quot;1&quot; 59: Phy FW &quot;1&quot;</td>
</tr>
<tr>
<td>60-61</td>
<td>2</td>
<td>Wavelength</td>
<td>Laser wavelength (Passive/Active Cable Specification Compliance)</td>
<td>00,00</td>
<td>RESERVED</td>
</tr>
<tr>
<td>62</td>
<td>1</td>
<td>Unallocated</td>
<td>Lower bit rate margin, units of %</td>
<td>00</td>
<td>NA</td>
</tr>
<tr>
<td>63</td>
<td>1</td>
<td>CC_BASE</td>
<td>Check code for Base ID Fields (addresses 0 to 62)</td>
<td>VARIES</td>
<td>VARIES</td>
</tr>
<tr>
<td>64-65</td>
<td>2</td>
<td>Options</td>
<td>Indicates which optional SFP signals are implemented</td>
<td>00,00</td>
<td>VARIES</td>
</tr>
<tr>
<td>66</td>
<td>1</td>
<td>BR, max</td>
<td>Upper bit rate margin, units of %</td>
<td>00</td>
<td>VARIES</td>
</tr>
<tr>
<td>67</td>
<td>1</td>
<td>BR, min</td>
<td>Lower bit rate margin, units of %</td>
<td>00</td>
<td>VARIES</td>
</tr>
<tr>
<td>68-83</td>
<td>16</td>
<td>Vendor SN</td>
<td>Serial number provided by vendor (ASCII)</td>
<td>VARIES</td>
<td>VARIES</td>
</tr>
<tr>
<td>84-91</td>
<td>8</td>
<td>Date code</td>
<td>Vendor’s manufacturing date code</td>
<td>VARIES</td>
<td>YY-MM-DD-LOT#</td>
</tr>
<tr>
<td>92</td>
<td>1</td>
<td>Diagnostic Monitoring Type</td>
<td>Indicates which type of diagnostic monitoring is implemented (if any)</td>
<td>00</td>
<td>None included</td>
</tr>
<tr>
<td>93</td>
<td>1</td>
<td>Enhanced Options</td>
<td>Indicates which optional enhanced features are implemented (if any)</td>
<td>00</td>
<td>None included</td>
</tr>
<tr>
<td>94</td>
<td>1</td>
<td>SFF-8472 Compliance</td>
<td>Indicates which revision of SFF-8472 the transceiver complies with</td>
<td>00</td>
<td>None included</td>
</tr>
<tr>
<td>95</td>
<td>1</td>
<td>CC_EXT</td>
<td>Check code for the Extended ID Fields (addr. 64 to 94)</td>
<td>VARIES</td>
<td>VARIES</td>
</tr>
</tbody>
</table>

Table 5: SFP+ MSA Serial ID Data
Protocol for I2C to MDIO Bridge

The Transceiver contains a Bridge device to allow the Host I2C interface to communicate with the PHY’s MDIO interface. In order for this to work the following protocol must be used.

The I2C Slave Address for the Bridge is 0x56 + R/W Bit or 0xAC for a write and 0xAD for a read.

To write to a PHY register the I2C Master needs to send a 6 Byte I2C frame. The first Byte is the I2C Slave Address with R/W Bit = 0 or 0xAC. The second Byte contains the 5 Bit MDIO Device Address in Bits 4:0 with Bits 7:5 = 0. The next 2 Bytes are the 16 Bit Register Address with the MSB first, and the last 2 Bytes are the 16 Bit Data with the MSB first.

To read from a PHY register the I2C Master needs to first send a 4 Byte I2C frame. The first Byte is the I2C Slave Address with R/W Bit = 0 or 0xAC. The second Byte contains the 5 Bit MDIO Device Address in Bits 4:0 with Bit 5 = 1 and Bits 7:6 = 0. The next 2 Bytes are the 16 Bit Register Address with the MSB first. Then the I2C Master starts a second frame by sending the I2C Slave Address with R/W Bit = 1 or 0xAD. The I2C Master will then receive 2 Bytes containing the 16 Bit Data with the MSB first from the Slave.

Examples:

Master  Slave  Start  Stop

Write 0x000A to DEVAD 1 Register 0xA819

S 1 0 1 0 1 1 0 0 0 0 0 0 0 0 1 0

1 0 1 0 1 0 0 0 0 0 0 1 1 0 0 1 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0

Read 0x000A from DEVAD 1 Register 0xA819

S 1 0 1 0 1 1 0 0 0 0 0 1 0

1 0 1 0 1 0 0 0 0 0 0 1 1 0 0 1 0

S 1 0 1 0 1 1 0 1 0 0 0 0 0 0 0 0

0 0 0 0 1 0 1 0 1 0