



eC-test-mate

# Hardware Reference Manual

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## Overview

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The eC-test-mate is a family of portable devices for production testing of printed circuit boards (PCBs). The devices (Test Heads) are controlled by a command language on a PC to which they are connected via USB. Each Test Head type provides a fixed number of functions. By combining multiple Test Heads, it is possible to create a customized set of test features.

Working voltages are in the range of 0..24V for most test functions (e.g. power supply, digital and analog I/O) except where this is not useful (e.g. UART or I2C). All inputs and outputs are protected against higher voltages however. Although care has been taken to protect the electronics as much as possible (see the description for each functional group in the corresponding Test Head Type chapter), applying too high voltages may result in damage to the device.

Unlike the TEST-OK fixture, the Test Heads are connected directly to the Unit Under Test (UUT hereafter) without an intermediate nail bed. In order to be testable with one or more Test Heads, it is necessary that the required pattern of test points and associated holes (the footprint) be present on the UUT. Each Test Head type has a unique footprint so that it is impossible to connect a Test Head to the wrong test points.

An eC-test-mate Docking Station is available as well. The main advantage of plugging a Test Head into the Docking Station is that the power that can be delivered by the Test Head's power supply is increased. The USB standard limits the output current to 500mA which results in a maximum output power of 2.5W. About 2W of this is available to the power supply. When connected to the eC-test-mate Docking Station, the maximum power that is available is 7W or 1A output current whichever limit is reached first.

## eC-test-mate types

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### **eC-test-mate Type I - green -**

General purpose tester with a power supply: four analog inputs, four analog outputs and four digital bidirectional in/outputs and four digital outputs and a UART for serial communication.

### **eC-test-mate Type II - blue -**

This type focuses on communication interfaces. Besides a power supply, two analog inputs and four digital bidirectional in/outputs and four digital outputs, interfaces for some common standards are provided: CAN, RS485, I2C and UART.

### **eC-test-mate Type III - red -**

Another general purpose tester with multiple functions on some pins for optimal flexibility. Eight pins can be used as analog input or digital input. Furthermore, four analog outputs are provided and one group of seven digital outputs with programmable logic '1' level.

As every eC-test-mate, a programmable power supply is available as well.

### **Combining eC-test-mates into a bigger tester**

If the Unit Under Test (UUT) requires more test points than there are available on one or when the mix of required test functions is not available from a specific eC-test-mate type, then it is possible to combine multiple eC-test-mates.

There is one restriction however: it is not possible to combine multiple eC-test-mates of the same type. It is easy to see why: since two identical eC-test-mates cannot be physically distinguished, it is possible to interchange the two eC-test-mates when connecting them to the UUT. Besides unexpected test results, this may even damage the UUT if e.g. the wrong power supply is set to a too high voltage.

In order to distinguish between common functions (like power supplies or digital/analog I/O) on different eC-test-mates, the functions are numbered with a global 3-digit numbering scheme in which the first digit indicates the eC-test-mate type. As an example, all eC-test-mates have at least one power supply. The power supply of Type I is Supply 101 while the one of Type II is Supply 201. The same applies e.g. to analog inputs: Type I has analog input 101..104 while Type III has analog inputs 301..308

## eC-test-mate Type I (TCC 211)

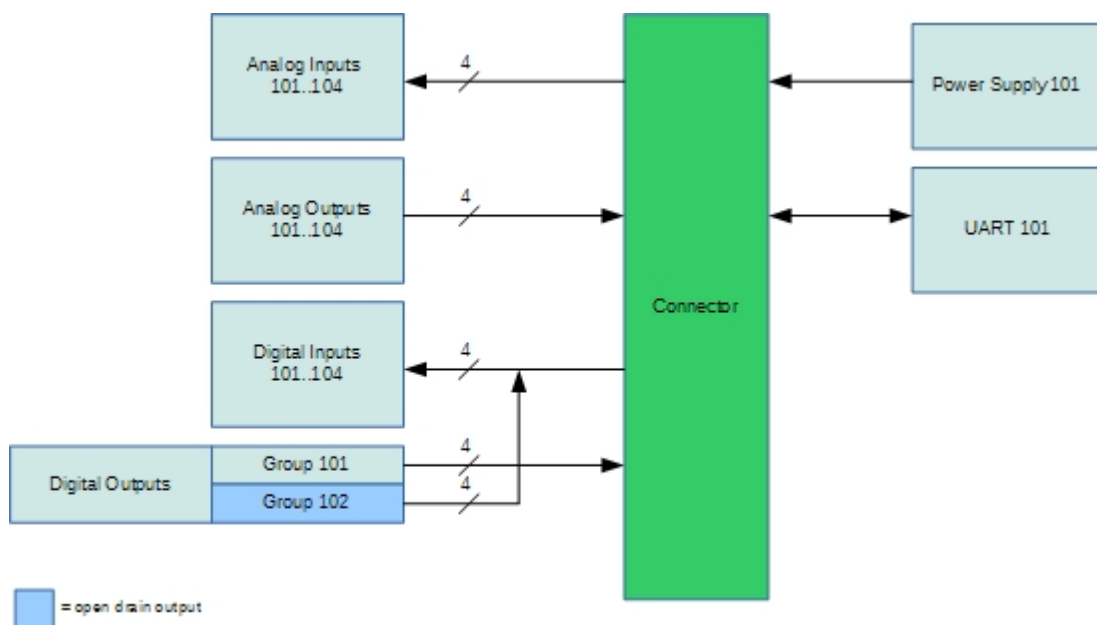
General purpose tester with a power supply: four analog inputs, four analog outputs and four digital bidirectional in/outputs and four digital outputs and a UART for serial communication.

### Functional description

This section describes all the functional blocks of the eC-test-mate Type I.

Besides the electrical specification of the interface pins on the connectors of the eC-test-mate Type I there are also references to the TEST-OK Description Language (TDL) commands that can be used to control the functional blocks.

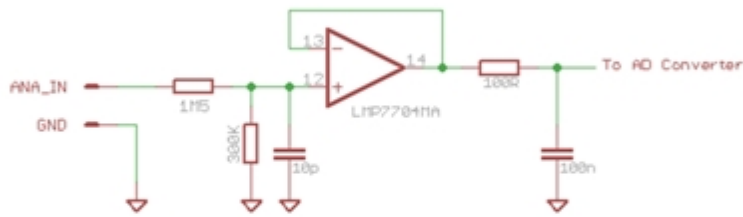
A block diagram of the eC-test-mate Type I is shown in the figure below:



The eC-test-mate Type I board is connected to a PC via USB. Via this connection, information about outputs to be set and values of inputs are exchanged about five times per second.

### Analog Inputs (101..104)

There are four identical high impedance analog inputs on the board which are fed into 12-bit Analog-to-Digital Converters (ADC for short). It is sampled at 2kHz and digitally filtered. The valid input voltage range is 100mV..24V, with a resolution of 1 mV.



*Drawing 1: Input stage of analog inputs*

### Input specifications

Input impedance:	1.8M
Input range:	100mV .. 24V
Resolution:	1 mV
Accuracy:	20mV or 0.2%
Sampling rate:	2kHz with digital filtering.

The maximum allowed input voltage that will not result in damage is 44V.

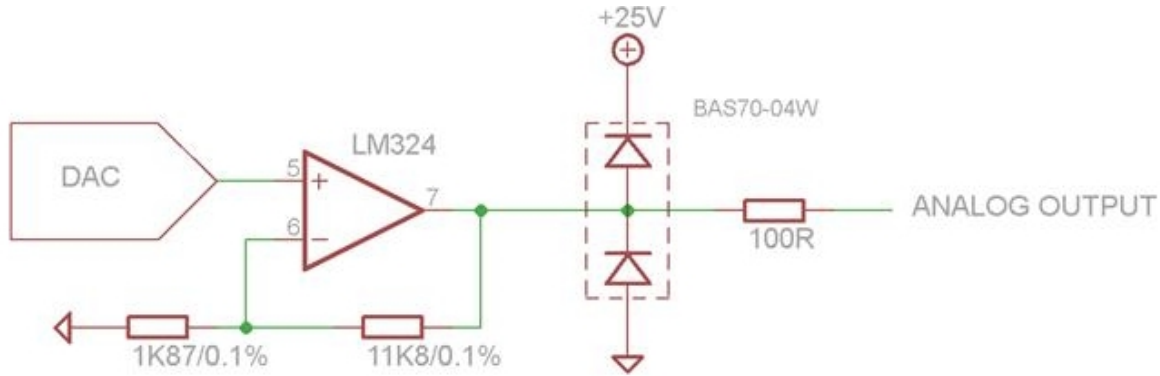
### Associated test command(s):

- TEST\_ANALOG
- MAP

## Analog Outputs (101..104)

Four identical analog outputs can be independently programmed with an output voltage between 0 and 24V. The output voltage is controlled by a 12-bit Digital-to-Analog Converter (DAC for short) and the resulting precision is therefore 6 mV.

*Note that voltages close to 0V may experience an error up to 30mV.*



The outputs are protected against short circuit by means of a 100  $\Omega$  series resistor. Clamping diodes protect the outputs against voltages above 26V and below 0V if such voltages were inadvertently applied to the outputs.

All outputs are set to 0V when communication is lost with the PC.

The maximum output current per channel is:

- 40 mA Source
- 20 mA Sink

*Note: however that there will be a voltage drop across the internal 100  $\Omega$  series resistor, resulting in a lower voltage on test pin.*

### Output specifications

Input range:	100mV .. 24V
Resolution:	6 mV
Accuracy:	
100mV .. 1V	20mV
1V and higher	0.1% (typically 0.05% above 3V)

### Associated test command(s):

- SET\_ANALOG
- MAP

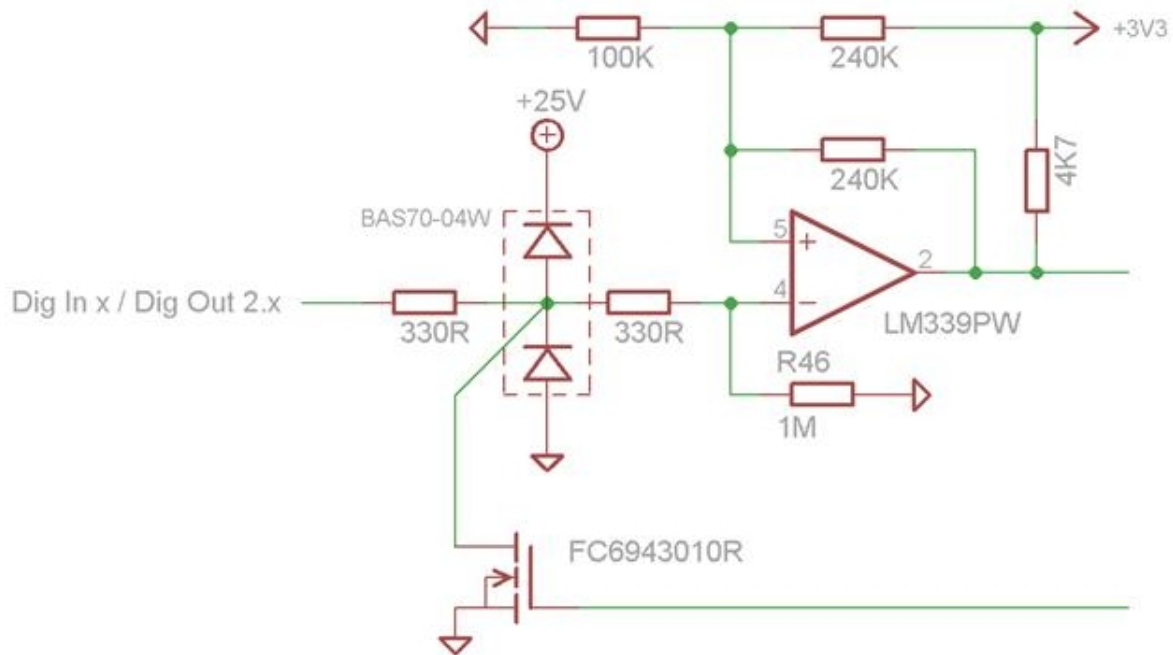
## Digital Inputs (101..104)

There are four digital inputs. The inputs contain a Schmitt trigger circuit and therefore have a hysteresis: the digital level goes from '0' to '1' at 1.5V while remains '1' until the voltage drops below 0.75V.

Input impedance: 1M

The maximum specified working input voltage is 24V. Clamping diodes protect the inputs against voltages above 25V and below 0V.

The maximum allowed input voltage that will not result in damage is 31V.



Some of the inputs have extra functionality:

### Inputs 101..104

Inputs 101..104 are located on the same test pins as (open collector) output bits 1..4 of group 102, making them useful for testing bidirectional signals.

*Note however the 330R resistor between the open collector output and the test pin!!!*

### Associated test command(s):

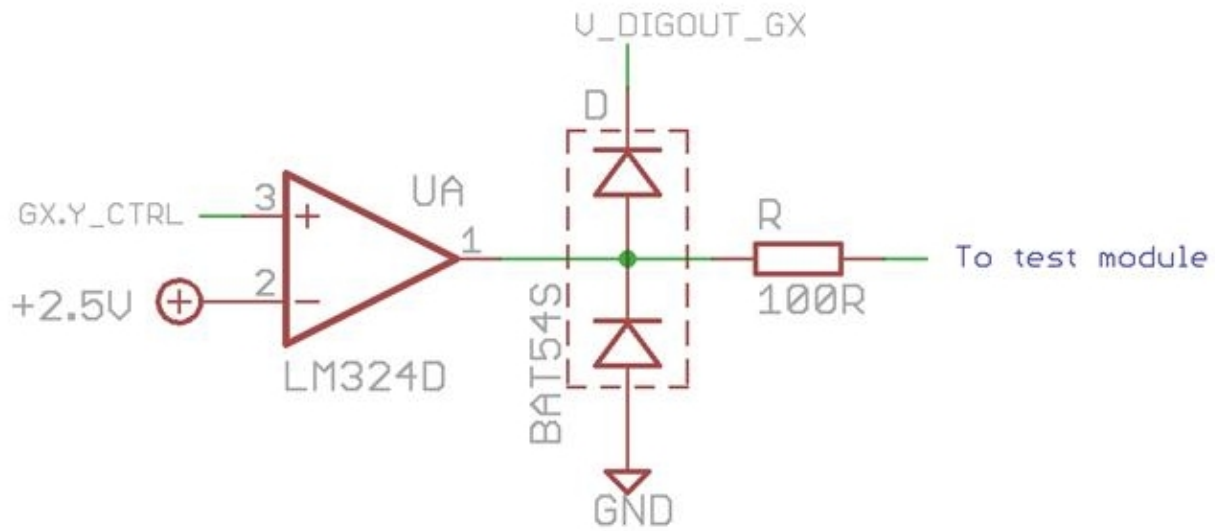
- TEST\_DIGITAL
- MAP



## Digital Outputs (Group 101 and 102)

For optimal flexibility, the digital outputs are separated into two groups. The output voltage corresponding to a '1' can be programmed separately for group 101. Group 102 has open drain outputs meaning that 'configuration' of the '1' output level must be done via an external pull-up resistor if necessary. All outputs are switched off when communication is lost with the PC.

### Group 101



Specifications:  $V_{\text{outH}} = 2.5..24\text{V}$ ,  
 $V_{\text{outL}} = 0\text{V}$   
 $I_{\text{source max}} = 40\text{mA}$ ,  $I_{\text{sink Max}} = 20\text{mA}$ ,  
 $R_{\text{out}} = 100$

Group 101, is protected against short circuit by means of a 100 series resistor. Clamping diodes protect the outputs against voltages above 25V and below 0V if such voltages were inadvertently applied to the outputs.

*Note: the internal 100R resistor can only dissipate 100mW. E.g. when the output is programmed for 5V and 24V is applied on the corresponding EC-test-mate pin, then there will be a voltage of 18.5V across the 100R resistor which would result in 3.4W dissipation!*

*Note: besides the maximum current, there is also a limit on dissipated power by the outputs. The total power dissipated by bits 1..4 shall not exceed 500mW*

*Note: the configured output voltage of Group 101 is also used to determine the logic '1' output level of the serial channel as long as the voltage is less or equal to 5V (above this voltage, the serial output is fixed to 5V independently of the Group 101 voltage)*

*Note: the outputs of group 101 are not rail-to-rail (LM324) and special care must be taken when the outputs must sink a pull-up on the UUT. If the load to be sunk is less than 10k, then an offset voltage will be present on the output. As an example, if a 1K pull-up to 5V is connected to an output, then the output voltage will not go lower than 1.4V!!*

### Group 102

Group 102 consists of four 'open drain' outputs, pulling the output to GND via a 330R series resistor. The

outputs share the same test pins as digital inputs 101..104 making these pins 'bi-directional'. Setting a '1' with the SET\_DIGITAL command on the open drain outputs will activate the output. I.e. the output will pulled to GND. When the output is pulled up to a positive voltage, the output may seem inverted since setting a '1' via the SET\_DIGITAL command will result in a '0' on the output!

*Note: due to the series resistor at the input pins, the open-drain outputs have this series resistor as well, resulting in a voltage divider. This may cause unexpected behaviour is low resistance pull-up resistors are present.*

**Associated test command(s):**

- CONFIG\_DIGITAL\_GROUP
- SET\_DIGITAL
- MAP

### Bi-Directional Digital I/O

With the eC-test-mate Type I, it is possible to test up to 4 bi-directional digital signals. As described in previous two sections, the 4 output bits of Group 102 are located on the same connector locations as digital inputs 101..104. Since the outputs are open-collector outputs, the line can be left floating by setting the output to '0'. A pull-up resistor shall be present on the UUT.

## Serial Channel (UART 101)

The serial channel is designed to work with signal levels up to 5V. The actual output voltage is equal to the voltage that is configured for Digital Output Group 101 if this voltage is equal or less than 5V. For higher Group 101 voltages, the Serial channel is fixed at 5V.

The Serial input has a fixed VIHmin of 1.7V.

The SERIAL\_TX pin is driven by a level shifter (SN74LVC1T45) with a series resistor of 100 . This means that the sink and source current of the output is limited.

The baud rate, parity and some other parameters can be configured via a configuration command.

Two buffers are associated with the serial channel, one for transmission and one for reception. Transmission is initiated by sending one or more bytes to the TEST-OK Board by means of the SERIAL\_TX command.

The bytes in this packet are copied to the transmit buffer and then sent over the serial interface using the configured baud rate and parity.

Received bytes are stored in the receive buffer. These bytes can be sent to the host in two ways: either on request of the host ('polling' mode) or when one of two configured conditions occur ('interrupt' mode): more than <n> bytes are present in the buffer (RxThreshold) or one or more bytes are present in the buffer and no new data is received for more than <t> milliseconds (RxTimeout).

When StxMode is enabled (see description below), then the reception of an ETX byte will also result in the buffer contents being sent to the PC.

The interrupt method is best and guarantees that there is no unnecessary delay between the reception of data and the availability on the host.

The RxTimeout method allows to synchronize with the stream of bytes from the target board when there is some time between two consecutive packets.

*Note 1: the naming of the connector pins is as seen from the eC-test-mate. SERIAL\_TX is therefore an output on which the data towards the UUT is provided by the EC-test-mate and SERIAL\_RX is an input on which data from the UUT is received.*

*Note 2: the output (transmit) driver on the eC-test-mate Type I has a 100R series resistor and may therefore not be able to source or sink excessive loads on the UUT. For higher baud rates, this may also have an impact on the wave forms.*

Configurable parameters and their default after start-up or reset:

Parameter	Description	Default Value
Baud rate	Baud rate of the serial channel. See the table below for information on the error % for standard baud rates. Non-standard baud rates are supported as well as long as they are in the range 300..11520 baud.	9600 baud
Parity	Determines whether a parity bit is sent and whether it is even or odd	No parity
RxInterrupt	If 'on', the TEST-OK Board will send RX_RECEIVE packets without waiting for a host request	Off
RxThreshold	Number of received bytes in the Rx buffer that will generate an 'interrupt'	32 bytes
RxTimeout	Time after which received bytes are sent to the host in the absence of new data	100 ms
StxMode	If set, the TEST-OK firmware will put STX and ETX bytes around the packet and DLE's will be inserted if necessary.	off

Some standard Baud Rates and their error percentage:

Baud Rate	Actual Rate	% Error
300	300	0.00
1200	1200	0.00
2400	2400	0.02
9600	9606	0.06
19200	19193	-0.03

57600	57803	0.35
115200	114.943	-0.22

### STX mode explained

Sending packets in STX mode is a way synchronize the receiver with the stream of bytes that is received. The principle (and implementation) is simple: each packet starts with a 'Start of Transmission' (STX) byte which has a unique value that will never be transmitted in the actual packet data. The end of a packet is marked with another unique value: the 'End of Transmission' byte (ETX). Synchronizing is now very easy for the receiver: as soon as an STX byte is received, the start of the packet is found and as soon as ETX is received, the packet has been completely received. Besides the synchronization, another advantage is that the receiving software does not need to have any knowledge about the packet size.

If the packet contains bytes with the same value as STX and ETX, then these values cannot be transmitted as such since this would make the receiver resynchronize on the start of a new packet or on the premature end of the current packet. Instead, a third unique value is defined to 'escape' the normal meaning of the special values. The DLE (Data Link Escape) byte is therefore inserted into the transmission on every occurrence of STX, ETX and DLE in the packet data. Thus, when receiving DLE, then this byte shall not be added to the packet but the next received byte shall be added without interpreting the received value as STX, ETX or DLE.

### Values used by the eC-test-mate Type I:

STX = 0x0F (15<sub>10</sub>)

ETX = 0x04 (4<sub>10</sub>)

DLE = 0x05 (5<sub>10</sub>)

### Associated test command(s):

- CONFIG\_SERIAL
- TRANSMIT\_SERIAL
- SET\_SERIAL
- TEST\_SERIAL
- WAITTX
- WAITRX

## Programmable Power Supply (Supply 101)

One independently programmable power supply is provided in order to power the board under test. The output voltage of the supplies is programmable from 1.26V..24V (in 12-bit resolution: 6 mV steps). The total available power depends on whether the eC-test-mate is connected to the dedicated eC-test-mate Docking Station or not. The USB standard limits the output current to 500mA which results in a maximum output power of 2.5W. About 2W of this is available to the power supply. When connected to the eC-test-mate Docking Station, the maximum power that is available is 4W or 1A output current whichever limit is reached first. The two figures at the end of this section show the available output current and power for a number of output voltages.

Note: trying to draw more power from a standard USB port than it can provide will result in the eC-test-mate to temporarily disconnect (due to a reset of the USB circuitry).

Worst case voltage output accuracy is 0.25%.

When switched off, the power supplies are disconnected from the connector.

Note that if a value lower than 1.26V is programmed, then the power supply will be set to 1.26V.

Note: The total power will be limited to 2W or 4W with a maximum output current of 1A, which means that at e.g. 20V output voltage, the maximum current is set to 0.1A or 0.2A while at 2V, the maximum output current is 1A with or without Docking Station.

The actual supply current is reported back to the PC and a current limit from 0..1A can also be programmed: when the programmed value is exceeded, the firmware of the eC-test-mate will switch off the supply and it will remain off until the host has reset the power supply (by switching it off and on again).

### Current measurement:

- Resolution: 1 mA
- Non-linearity over full range: 0.9% typical

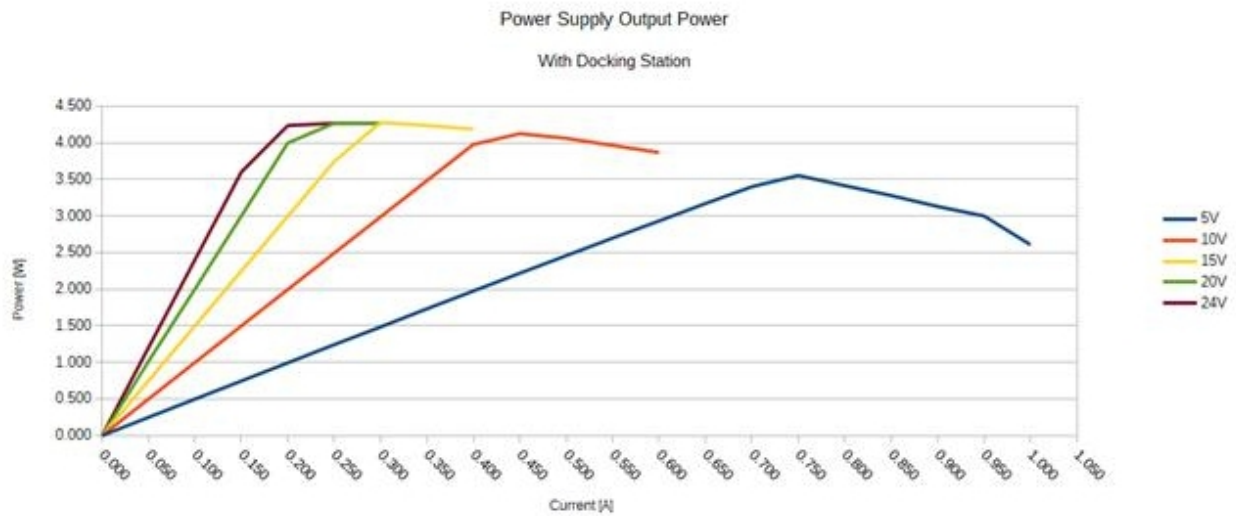
The power supply will also shut-down when communication is lost with the PC.

### Associated test command(s):

- CONFIG\_SUPPLY
- SET\_SUPPLY
- TEST\_SUPPLYCURRENT

The two figures below show the available power/output current for a number of output voltages.





## Board Presence

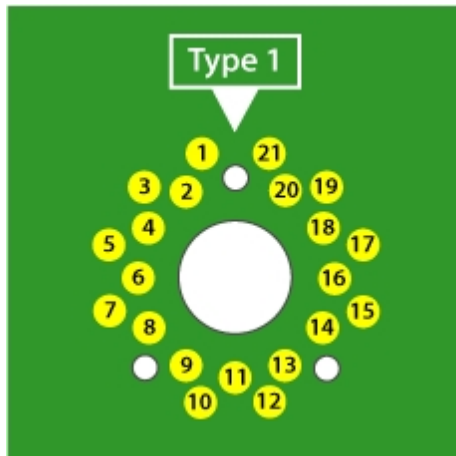
A test pin with internal pull-up is available in order to detect whether the eC-test-mate is connected to the PCB under test or not. Connect the corresponding test pad on the PCB under test to GND. The pin is called BOARD\_DETECT.

*Note: it is mandatory that the Board Detect pin of every eC-test-mate that is used in a test is connected to GND on the UUT when using the TEST-TRACK or eC-my-test software, since a test cannot be started when no board under test is detected. The board presence is used to determine whether a test can be started. If there is no board present, no test can be started.*

### Associated test commands:

- DISABLE\_BOARDDETECT
- ENABLE\_BOARDDETECT

## Pin assignment Type I



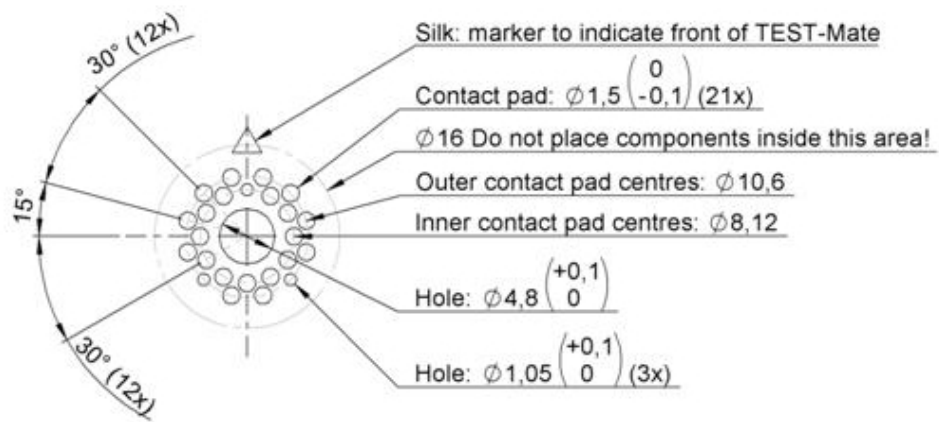
Pin	Function	Range
1	Board Detect	-
2	Analog Input 101	100mV..24V, 1mV resolution (12-bit ADC)
3	Analog Input 102	
4	Analog Input 103	
5	Analog Input 104	
6	Analog Output 101	0..24V, 6mV resolution (12-bit DAC)
7	Analog Output 102	
8	Analog Output 103	
9	Analog Output 104	
10	Digital Input 101 Digital Output 102.1	Input: 0..24V Output: Open drain
11	Digital Input 102 Digital Output 102.2	Input: 0..24V Output: Open drain
12	Digital Input 103 Digital Output 102.3	Input: 0..24V Output: Open drain
13	Digital Input 104 Digital Output 102.4	Input: 0..24V Output: Open drain
14	Digital Output 101.1	Output: 2.5..24V, 6mV resolution (12-bit DAC)
15	Digital Output 101.2	
16	Digital Output 101.3	
17	Digital Output 101.4	
18	UART 101 TX	300..115200 Baud
19	UART 101 RX	TX: 2.5..5V, RX 5V logic '1' level
20	Supply 101	1.5..24V, 6mV resolution (12-bit DAC) Max. 7W or 1A when used with TEST-Mate docking station. Without the docking station, the maximum depends on the power capabilities of the USB port (2W typical)
21	GND	-

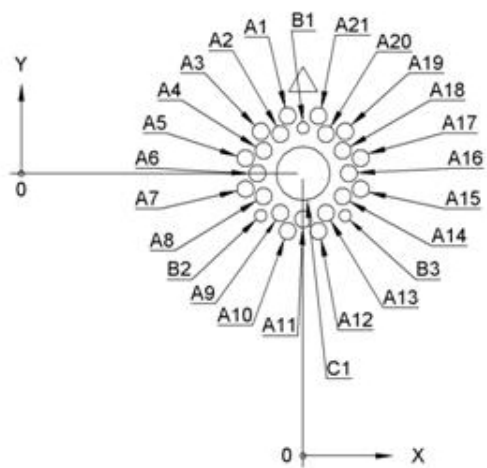




## Footprint technical drawings Type I

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Hole Table			
TAG	X LOC	Y LOC	SIZE
A1	-1.37	5.12	Contact pad: $\phi 1.5$ $\begin{smallmatrix} 0 \\ -0.1 \end{smallmatrix}$
A2	-2.03	3.52	
A3	-3.75	3.75	
A4	-3.52	2.03	
A5	-5.12	1.37	
A6	-4.06	0	
A7	-5.12	-1.37	
A8	-3.52	-2.03	
A9	-2.03	-3.52	
A10	-1.37	-5.12	
A11	0	-4.06	
A12	1.37	-5.12	
A13	2.03	-3.52	
A14	3.52	-2.03	
A15	5.12	-1.37	
A16	4.06	0	
A17	5.12	1.37	
A18	3.52	2.03	
A19	3.75	3.75	
A20	2.03	3.52	
A21	1.37	5.12	
B1	0	4.06	Hole: $\phi 1.05$ $\begin{smallmatrix} +0.1 \\ 0 \end{smallmatrix}$ THRU
B2	-3.75	-3.75	
B3	3.75	-3.75	
C1	0	0	Hole: $\phi 4.8$ $\begin{smallmatrix} +0.1 \\ 0 \end{smallmatrix}$ THRU

## eC-test-mate Type II (TCC 212)

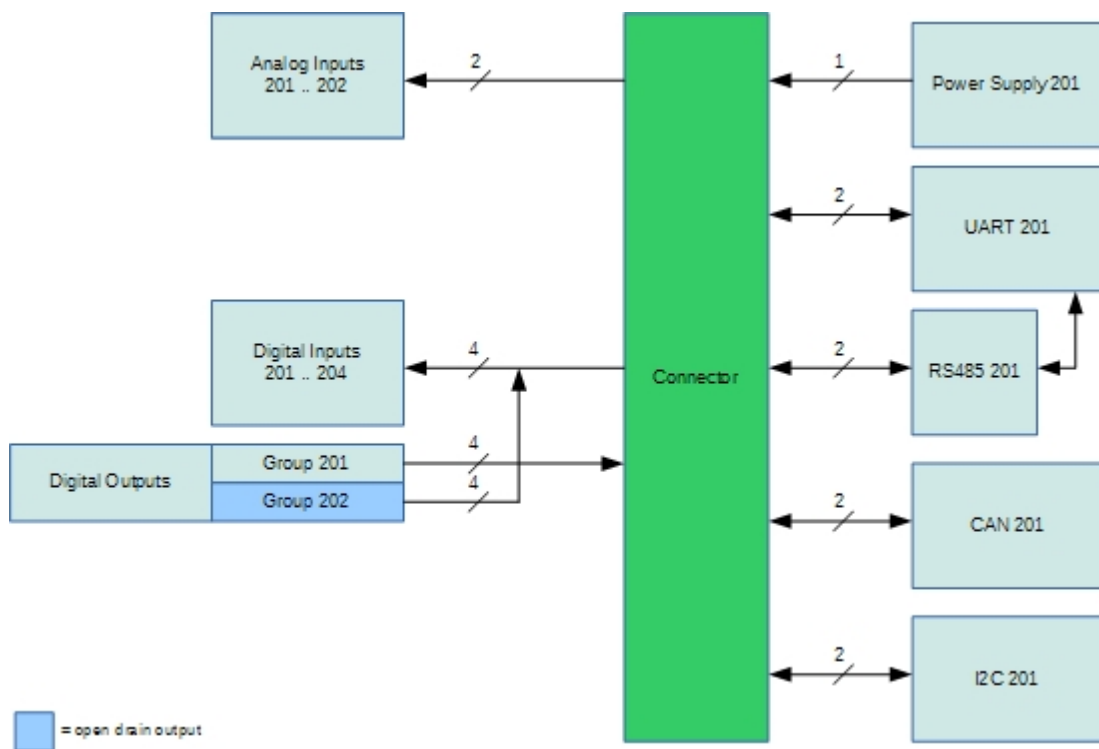
This type focuses on communication interfaces. Besides a power supply, two analog inputs and four digital bidirectional in/outputs and four digital outputs, interfaces for some common standards are provided: CAN, RS485, I2C and UART.

### Functional Description

This section describes all the functional blocks of the eC-test-mate Type II which is specialized for testing UUTs with communication interfaces.

Besides the electrical specification of the interface pins on the connectors of the eC-test-mate Type II there are also references to the TEST-OK Description Language (TDL) commands that can be used to control the functional blocks.

A block diagram of the eC-test-mate Type II is shown in the figure below:



As can be seen from the diagram, the numbering of inputs, outputs and other functions start at 201. The reason is that multiple eC-test-mate types can be combined into one bigger tester. The first digit indicates the eC-test-mate type (2) while the last two digits increment up from 1.

*Note that the UART and RS485 blocks use the same internal UART, resulting in only one of the two blocks being active.*

### Analog Inputs (201..202)

There are two identical high impedance analog inputs (numbered 201 and 202) on the board which are fed into 12-bit Analog-to-Digital Converters (ADC for short).

The valid input voltage range is 100mV..24V, with a resolution of 1 mV.

See [Analog Inputs \(101..104\)](#) for a detailed description of the specifications.

## Digital Inputs (201..204)

There are four digital inputs, numbered 5..8. The inputs contain a Schmitt trigger circuit and therefore have a hysteresis: the digital level goes from '0' to '1' at 1.5V while remains '1' until the voltage drops below 0.75V. The inputs are identical to those of Type I. See [Digital Inputs \(101..104\)](#) for a detailed description of the specifications.

## Digital Outputs (Group 201 and 202)

For optimal flexibility, the digital outputs are separated into two groups: Group 201 and 202. The output voltage corresponding to a '1' can be programmed separately for group 201. Group 202 has open drain outputs meaning that 'configuration' of the '1' output level must be done via an external pull-up resistor if necessary. The 4 output bits of Group 202 are located on the same connector locations as digital inputs 201..204.

See [Digital Outputs \(Group 101 and 102\)](#) for a detailed description of the specifications: Group 201 shares the specification of Group 101 and Group 202 shares those of Group 102.

## Bi-Directional Digital I/O

With the eC-test-mate Type II, it is possible to test up to 4 bi-directional digital signals.

As described in previous section, the 4 output bits of Group 202 are located on the same connector locations as digital inputs 201..204. Since the outputs are open-collector outputs, the line can be left floating by setting the output to '0'. A pull-up resistor shall be present on the UUT.

## Serial Channel (UART 201)

The serial channel (numbered as '201') is designed to work with signal levels up to 5V. The actual output voltage is determined by the voltage that is applied to the UART\_VCC test pin as long as this voltage is equal or less than 5V. For higher voltages, the Serial channel is fixed at 5V.

### UART\_VCC (input)

This pin determines the logic '1' level of the UART\_TX output and MUST BE CONNECTED to the appropriate voltage on the UUT.

Typical working voltage range is 1.7..5.0V. Absolute maximum voltage is 24V.

The current drawn from this pin consists of a quiescent current of about 4µA.

### The UART\_TX (output)

The transmit output is driven by a level shifter (SN74LVC1T45) with a series resistor of 100 Ω. This means that the sink and source current of the output is limited.

### UART\_RX (input)

The Serial input has a fixed VIHmin of 1.7V, independent of the voltage that is applied to the UART\_VCC input.

*Note 1: The UART\_VCC test pin must be connected on the UUT to a voltage that corresponds with the logic '1' level of the serial interface. If left open, the UART\_TX output will NOT work.*

*Note 2: The internal eC-test-mate UART is shared between the UART test pins and the RS485 test pins. Depending on the last configuration command, either the UART pins or RS485 pins will be active. Inactivity for the UART TX pin is defined as a constant '1' level.*

See [Serial Channel \(UART 101\)](#) for the configurable parameters (baud rate etc).

## RS485 (RS485 201)

A full-duplex RS485 interface including a 120  $\Omega$  termination resistor is provided with bit rates up to 200kb/s. When not activated, the driver will be in the high-impedance state.

### Specifications (Texas Instruments SN65HVD3082E):

Voltage at any bus terminal (separately or common mode): -7V..+12V  
Driver output current: -60..+60 mA

*Note 1: The internal eC-test-mate UART is shared between the UART test pins and the RS485 test pins. Depending on the last configuration command, either the UART pins or RS485 pins will be active. If the RS485 interface is inactive, the eC-test-mate's RS485 driver will be in the high-impedance state.*

See section [Serial Channel \(UART 101\)](#) for the configurable parameters (baud rate etc).

### Associated test command(s):

- CONFIG\_RS485
- TRANSMIT\_RS485
- RECEIVE\_RS485

## CAN (CAN 201)

An ISO 11898-5 compliant CAN transceiver interface with up to 1Mb/s operation is provided. The interface is terminated with a 120  $\Omega$  resistor.

### Electrical Specifications (Microchip MCP2562):

Absolute maximum voltage range: -58V to +58V  
Dominant output voltage: CANH = 3.5V, CANL = 1.5V  
Recessive output voltage: CANH, CANL = 2.5V

### Short circuit output current

CANH: -120..+85mA  
CANL: +75..+120mA

*Note: no other protection is added to the CAN bus.*

### Supported baud rates are as follows:

- 20 kbps
- 25 kbps
- 50 kbps
- 80 kbps
- 100 kbps
- 125 kbps
- 200 kbps
- 250 kbps
- 500 kbps
- 625 kbps
- 1 Mbps

### Associated test command(s):

- CONFIG\_CAN
- TRANSMIT\_CAN
- RECEIVE\_CAN

## I2C (I2C 201)

The I2C interface acts as a master. No pull-up resistors are provided meaning that the UUT's pull-up resistors determine the voltage level for the inactive state.

The SCL output and SDA input/output are protected against short circuit by means of a 100  $\Omega$  series resistor. Transient Voltage diodes protect the outputs against voltages above 5V if such a voltage is inadvertently applied to the test pins.

Applying more than 8V for longer periods to these test pins may damage the eC-test-mate.

Currently, the SCL clock frequency is fixed at 100kHz

### Associated test command(s):

- I2C\_START
- I2C\_WRITE
- I2C\_READ
- I2C\_STOP

## Programmable Power Supply (Supply 201)

One independently programmable power supply is provided in order to power the board under test. The output voltage of the supplies is programmable from 1.26..24V (in 12-bit resolution: 6 mV steps).

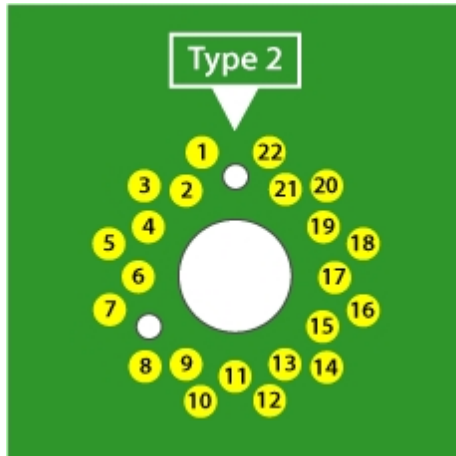
This power supply is identical to the one of Type I. See [Programmable Power Supply \(Supply 101\)](#) for full specifications.

## Board Presence

See [Board Presence](#) for a detailed description of this function.

*Note: this pin MUST be connected to GND on the PCB under test.*

## Pin assignment Type II



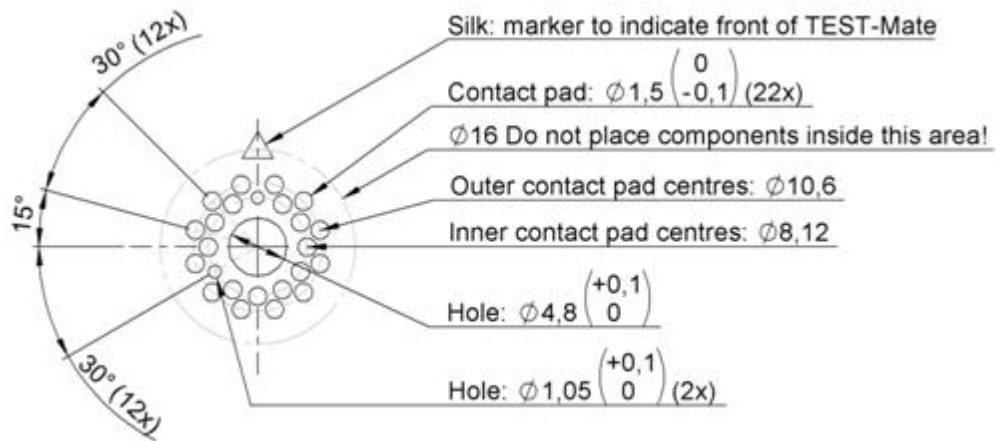
Pin	Function	Range
1	Board Detect	-
2	Analog Input 201	100mV..24V, 1mV resolution (12-bit ADC)
3	Analog Input 202	
4	RS485 201 A	RS485
5	RS485 201 B (inverting)	
6	CAN 201 L	CAN
7	CAN 201 H	
8	I2C 201 SDA	I2C
9	I2C 201 SDL	
10	Digital Input 201 Digital Output 202.1	Input: 0..24V Output: Open drain
11	Digital Input 202 Digital Output 202.2	Input: 0..24V Output: Open drain
12	Digital Input 203 Digital Output 202.3	Input: 0..24V Output: Open drain
13	Digital Input 204 Digital Output 202.4	Input: 0..24V Output: Open drain
14	UART 201 VCC	0..5V typical, 0..24V allowed
15	Digital Output 201.1	Output: 2.5..24V, 6mV resolution (12-bit DAC)
16	Digital Output 201.1	
17	Digital Output 201.1	
18	Digital Output 201.1	
19	UART 201 TX	300..115200 Baud
20	UART 201 RX	TX: 2.5..5, determined by pin 14, RX 5V logic '1' level.
21	Supply 201	1.5..24V, 6mV resolution (12-bit DAC) Max. 7W or 1A when used with TEST-Mate docking station. Without the docking station, the maximum depends on the power capabilities of the USB port (2W typical)
22	GND	-

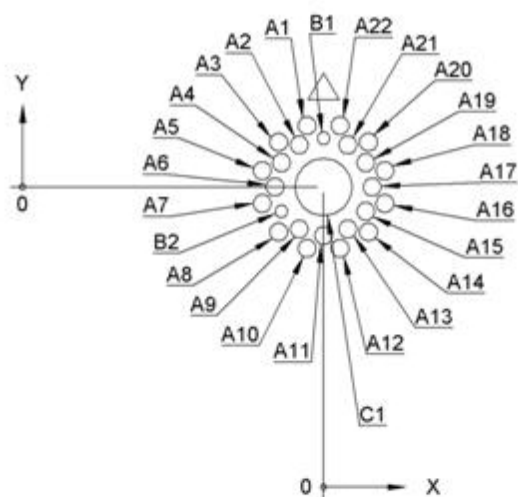




## Footprint technical drawing Type II

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Hole Table			
TAG	X LOC	Y LOC	SIZE
A1	-1,37	5,12	Contact pad: $\varnothing 1,5 -0,1$
A2	-2.03	3.52	
A3	-3.75	3.75	
A4	-3.52	2.03	
A5	-5.12	1.37	
A6	-4.06	0	
A7	-5.12	-1.37	
A8	-3.74	-3.74	
A9	-2.03	-3.52	
A10	-1.37	-5.12	
A11	0	-4.06	
A12	1.37	-5.12	
A13	2.03	-3.52	
A14	3.74	-3.74	
A15	3.52	-2.03	
A16	5.12	-1.37	
A17	4.06	0	
A18	5.12	1.37	
A19	3.52	2.03	
A20	3.75	3.75	
A21	2.03	3.52	
A22	1.37	5.12	
B1	0	4,06	Hole: $\varnothing 1,05$ $\begin{matrix} +0,1 \\ 0 \end{matrix}$ THRU
B2	-3.52	-2.03	
C1	0	0	Hole: $\varnothing 4,8$ $\begin{matrix} +0,1 \\ 0 \end{matrix}$ THRU

## eC-test-mate Type III (TCC 213)

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Another general purpose tester with multiple functions on some pins for optimal flexibility. Eight pins can be used as analog input or digital input. Furthermore, four analog outputs are provided and one group of seven digital outputs with programmable logic '1' level.

As every eC-test-mate, a programmable power supply is available as well.

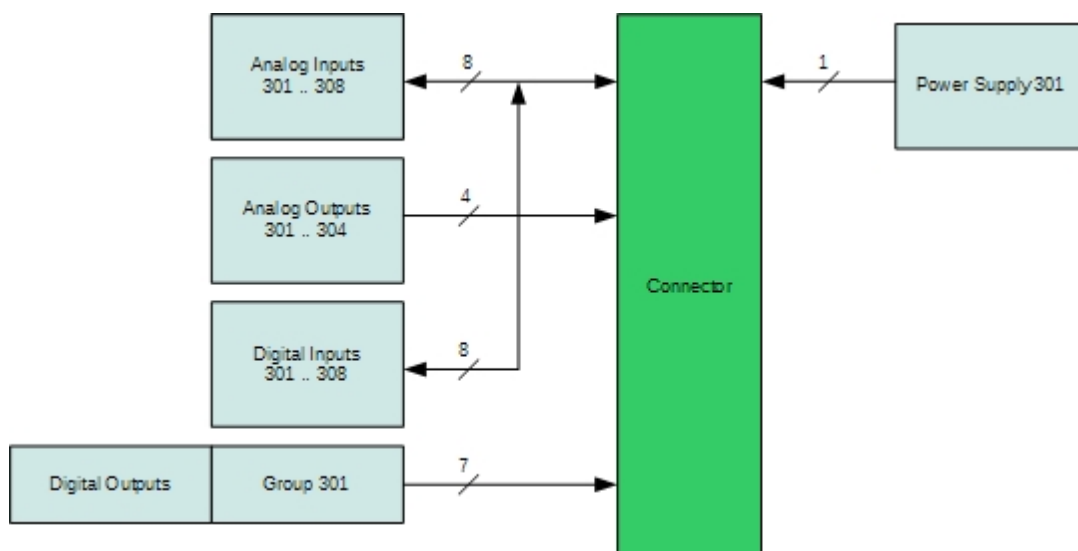
### Functional description

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This section describes all the functional blocks of the eC-test-mate Type III.

Besides the electrical specification of the interface pins on the connectors of the eC-test-mate Type III there are also references to the TEST-OK Description Language (TDL) commands that can be used to control the functional blocks.

A block diagram of the eC-test-mate Type III is shown in the figure below:

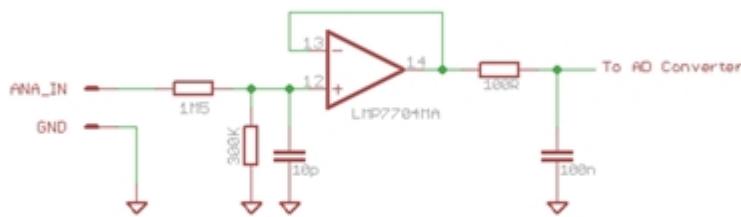


As can be seen from the diagram, the numbering of inputs, outputs and other functions start at 301. The reason is that multiple eC-test-mate types can be combined into one bigger tester. The first digit indicates the eC-test-mate type (3) while the last two digits increment up from 1.

### Analog Inputs (301..308)

There are eight identical high impedance analog inputs (numbered 301..308) on the board which are fed into 12-bit Analog-to-Digital Converters (ADC for short).

The valid input voltage range is 0..24V, with a resolution of 1 mV.



*Drawing 1: Input stage of analog inputs*

### Input specifications

Input impedance:	1.8M
Input range:	0 .. 24V
Resolution:	1 mV
Accuracy:	5mV or 0.1%
Sampling rate:	2kHz with digital filtering.

The maximum allowed input voltage that will not result in damage is 44V.

### Analog Outputs (301..304)

There are four analog outputs that can be independently programmed with an output voltage between 0 and 24V.

See [Analog Outputs \(101..104\)](#) for a detailed description of the specifications.

### Digital Inputs (301..308)

There are eight digital inputs, numbered 301..308 which are in fact software representations of the eight analog inputs which have a pre-programmed hysteresis: the digital level goes from '0' to '1' at 1.5V while remains '1' until the voltage drops below 0.75V.

### Digital Outputs (Group 301)

A total of seven digital outputs are provided. The output voltage corresponding to a '1' can be programmed. See [Digital Outputs \(Group 101 and 102\)](#) for a detailed description of the specifications: Group 301 shares the specification of Group 101.

### Programmable Power Supply (Supply 301)

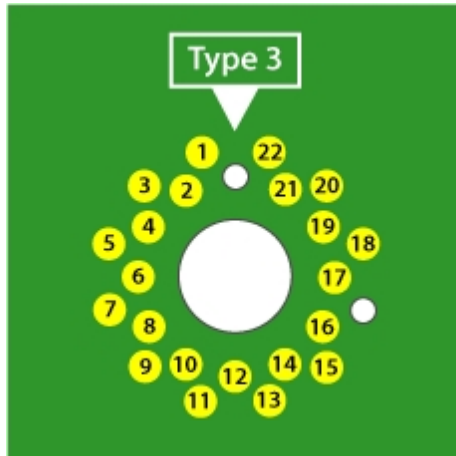
One independently programmable power supply is provided in order to power the board under test. The output voltage of the supplies is programmable from 1.26..24V (in 12-bit resolution: 6 mV steps). This power supply is identical to the one of Type I. See [Programmable Power Supply \(Supply 101\)](#) for full specifications.

### Board Presence

See [Board Presence](#) for a detailed description of this function.

*Note: this pin MUST be connected to GND on the PCB under test.*

## Pin assignment Type III



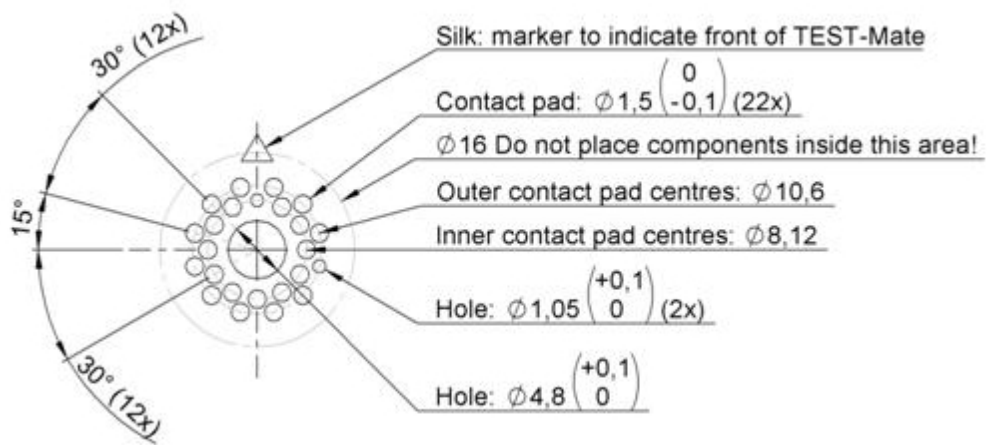
Pin	Function	Range
1	Board Detect	
2	Analog Output 301	0..24V, 6mV resolution (12-bit DAC)
3	Analog Output 302	
4	Analog Output 303	
5	Analog Output 304	
6	Analog Input 301 Digital Input 301	Analog Inputs: 0..24V, 1mV resolution (12-bit ADC) Digital Inputs: logical '1' level derived from analog value in firmware
7	Analog Input 302 Digital Input 302	
8	Analog Input 303 Digital Input 303	
9	Analog Input 304 Digital Input 304	
10	Analog Input 305 Digital Input 305	
11	Analog Input 306 Digital Input 306	
12	Analog Input 307 Digital Input 307	
13	Analog Input 308 Digital Input 308	
14	Digital Output 301.1	Output: 2.5..24V, 6mV resolution (12-bit DAC)
15	Digital Output 301.2	
16	Digital Output 301.3	
17	Digital Output 301.4	
18	Digital Output 301.5	
19	Digital Output 301.6	
20	Digital Output 301.7	
21	Supply 301	1.5..24V, 6mV resolution (12-bit DAC)

		Max. 7W or 1A when used with TEST-Mate docking station. Without the docking station, the maximum depends on the power capabilities of the USB port (2W typical)
22	GND	-

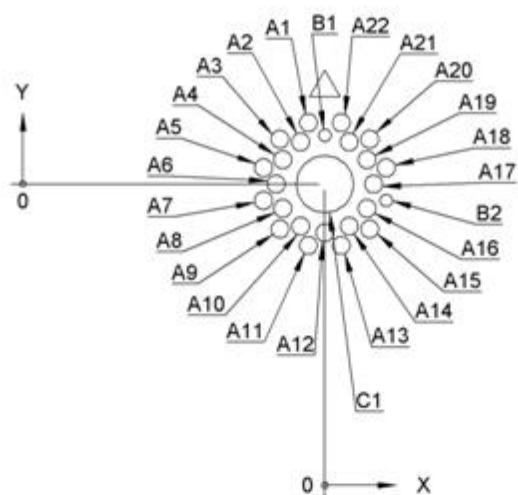


## Footprint technical drawing Type III

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Hole Table			
TAG	X LOC	Y LOC	SIZE
A1	-1,37	5,12	Contact pad: $\varnothing 1,5 - 0,1$
A2	-2,03	3,52	
A3	-3,75	3,75	
A4	-3,52	2,03	
A5	-5,12	1,37	
A6	-4,06	0	
A7	-5,12	-1,37	
A8	-3,52	-2,03	
A9	-3,74	-3,74	
A10	-2,03	-3,52	
A11	-1,37	-5,12	
A12	0	-4,06	
A13	1,37	-5,12	
A14	2,03	-3,52	
A15	3,74	-3,74	
A16	3,52	-2,03	
A17	4,06	0	
A18	5,12	1,37	
A19	3,52	2,03	
A20	3,75	3,75	
A21	2,03	3,52	
A22	1,37	5,12	
B1	0	4,06	Hole: $\varnothing 1,05 - 0,1$ THRU
B2	5,12	-1,37	
C1	0	0	Hole: $\varnothing 4,8 - 0,1$ THRU

## eC-test-mate Docking Station

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The Docking Station has two functions: first of all it allows the power supplies of connected eC-test-mates to provide up to 7W instead of 2W when connected to a regular USB port. Second, eC-test-mates connected to the Docking Station are electrically isolated from the PC and from the mains power supply.

For correct functioning of the eC-test-mate kit only use the adapter that is provided with the Docking Station (a medical type AC-DC adapter, 9VDC 25-30 Watt)

## eC-test-mate Dimensions

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