AN for VINcoNPC X12 (L40X)

How to drive it, using the GD-M40X Vincotech gate driver

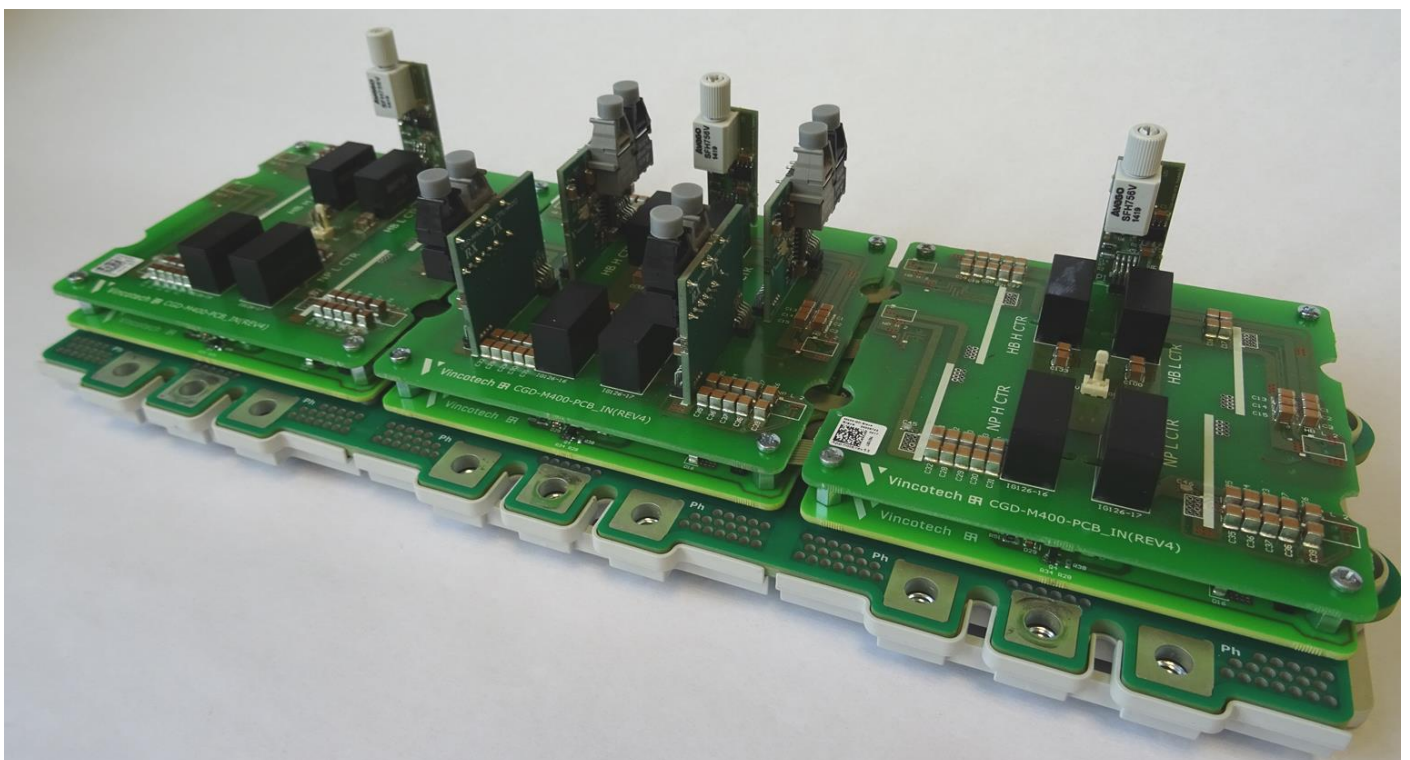## Table of Contents

Revision History

Date	Revision Level	Description	Page Number(s)
31.10.2017	1	First release	16

1   Abstract

This application note describes suitable Vincotech gate driver assembly for the 2400 V / 1200 A power module (70-W624N3A1K2SC-L400FP).

2   Introduction

The 70-W624N3A1K2SC-L400FP is a new member of the Vincotech power modules family VINcoNPC X12. With its increased power rating of 2400 V / 1200 A it targets the solar inverter, UPS and high speed motor drive market as well. To learn more about Vincotech modules, please visit: www.vincotech.com

3   The power module

This product is the latest high efficient NPC topology in VINco X12 housing (*figure 2*). With a neutral point clamped (NPC) topology the modules' system voltage is twice the component voltage. The high speed IGBT4 in boost switch position and low power IGBT4 in boost switch position it is an optimal component choice.
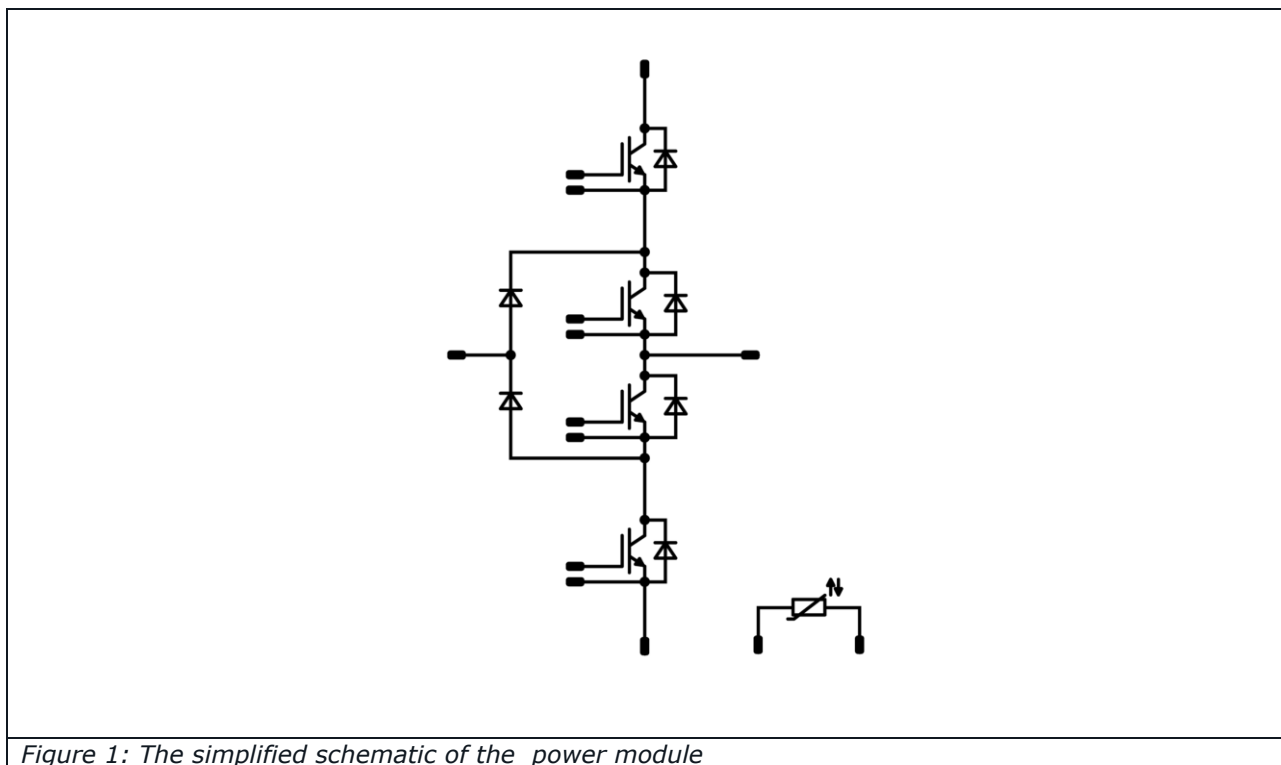
Figure 1: The simplified schematic of the power module
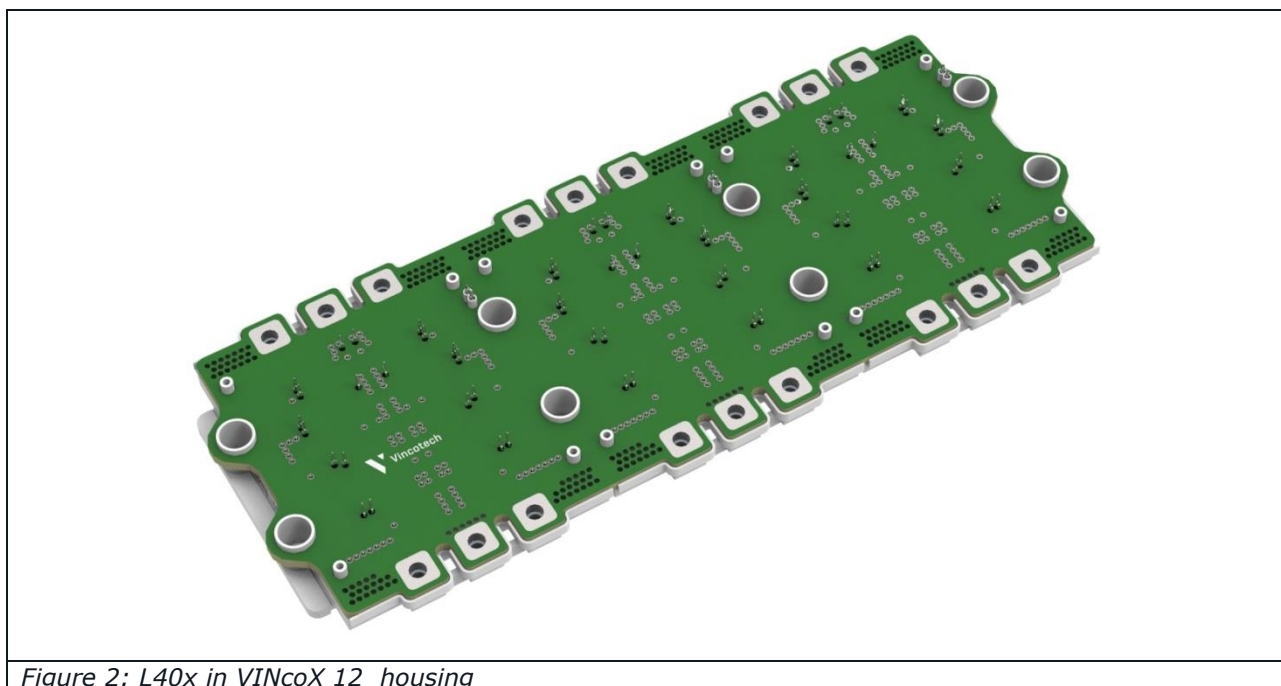
Figure 2: L40x in VINcoX 12 housing

3.1 Mechanical dimensions, housing

The main dimensions of the 70-W624N3A1K2SC-L400FP power module can be seen on *figure 3*. This new housing is from the "power" point of view a triplication of VINco X4 and joined together with its common PCB. The input screw connections: **DC+**, **GND**, **DC-**, and the output screw connections: **Ph,** are joined together through the top PCB. Nevertheless, these input junctions still have to be connected together externally, while paying a special attention to a symmetrical connection to achieve a balanced current sharing.
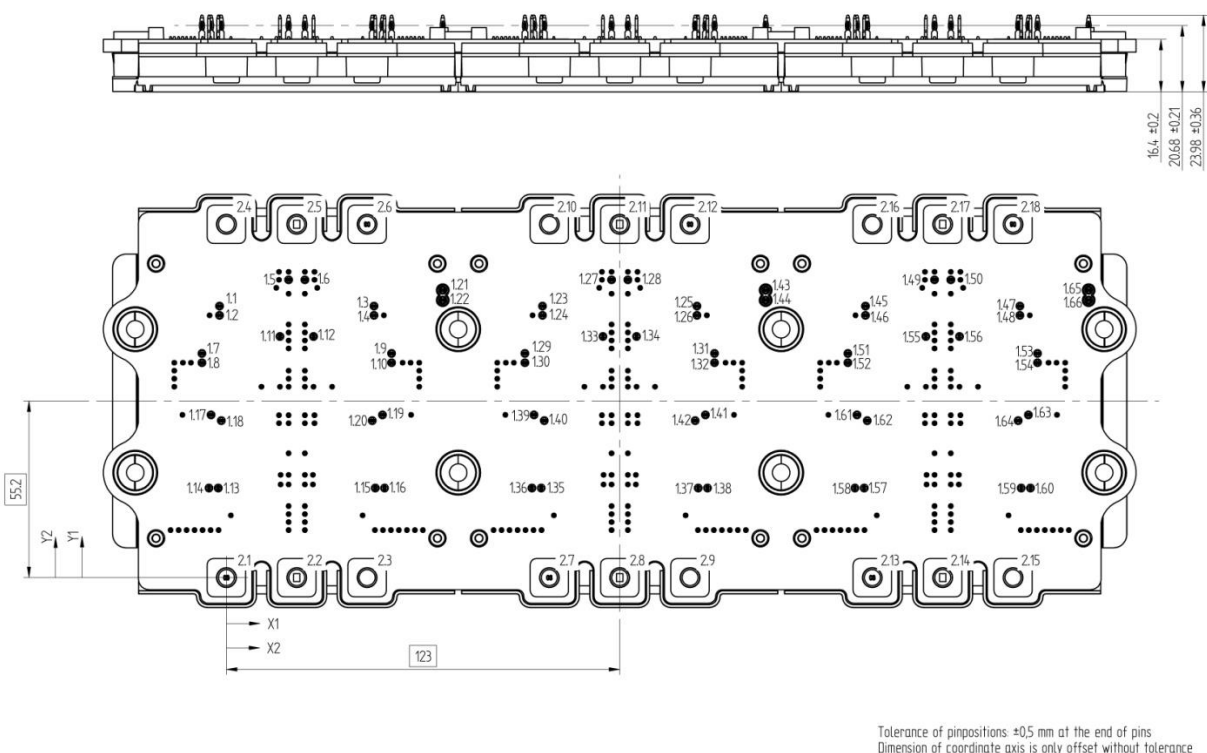
Figure 3: VINco X12 housing dimensions

3.2 Schematic

The schematic at topology level is shown at *figure 4*. *Table 1* gives the basic function of each component and their voltage/current ratings.

Figure 5 shows the parallel connection and the pin assignment of the three NPC cells.
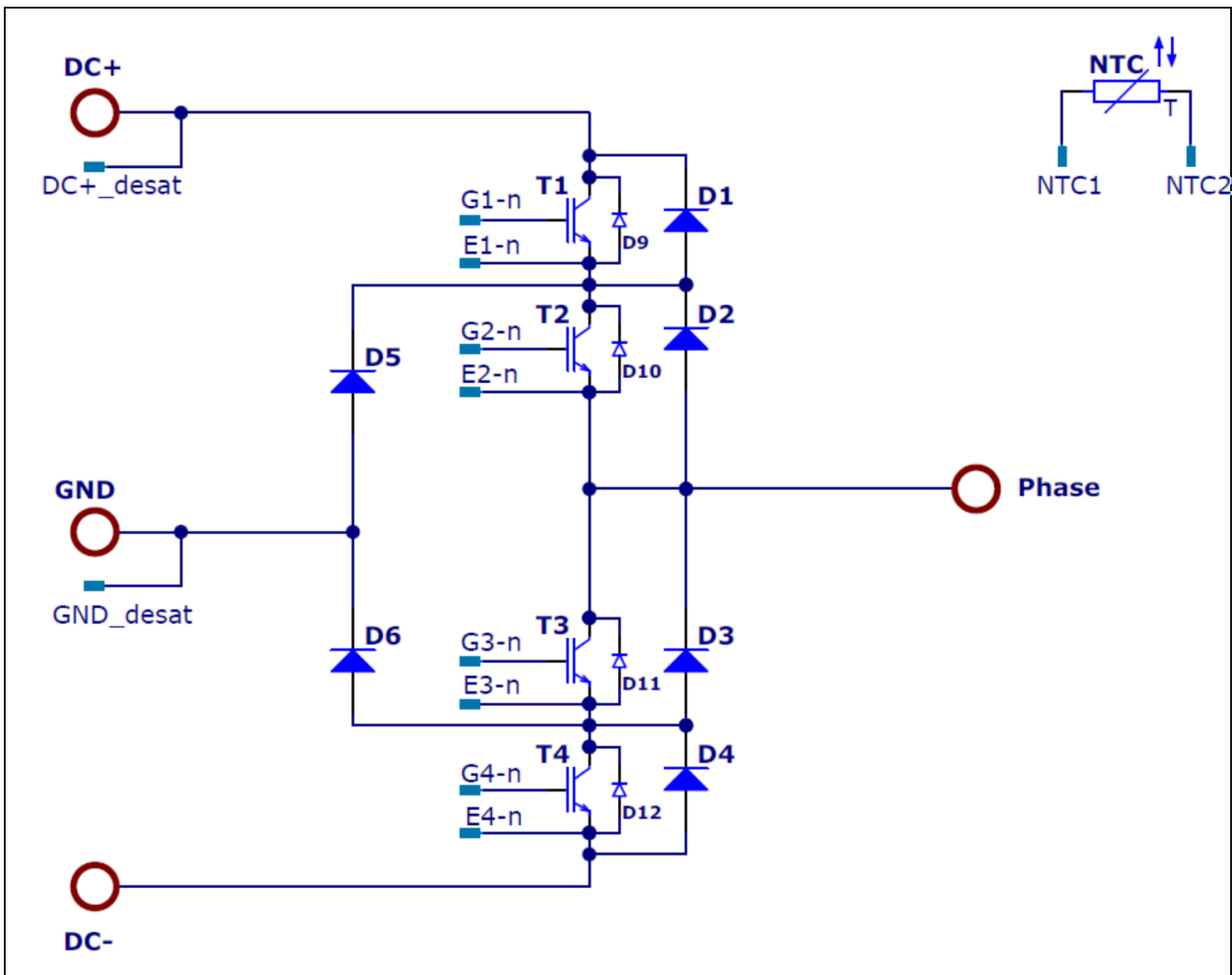
Figure 4: Schematic of the topology

ID	Component	Voltage	Current	Function
T1, T4	IGBT	1200 V	1200A	Buck Switch
D5, D6	FWD	1200 V	1200A	Buck Diode
T2, T3	IGBT	1200 V	1200A	Boost Switch
D1, D4	FWD	1200 V	1200A	Boost Diode
D2, D3	FWD	1200 V	1200 A	Boost Inverse Diode
NTC	NTC			Thermistor

Table 1: Components , function , voltage /current rating

Figure 5: Parallel connection of the 3 NPC cells

4   The gate driver of VINcoNPC X12 (L40x)

Figure 6: Parallel connection

As the VINcoNPC X12 is a successor of VINcoNPC X4 it is obvious to use the same gate driver for the former and the latter. Vincotech developed for the M40X module family its own gate driver **GD-M400-Master** and **GD-M400-Slave**. These gate givers can operate in stand-alone or master-slave mode. So for L40X we can use the GD-M400 gate drivers in a SLAVE–MASTER-SLAVE configuration as wil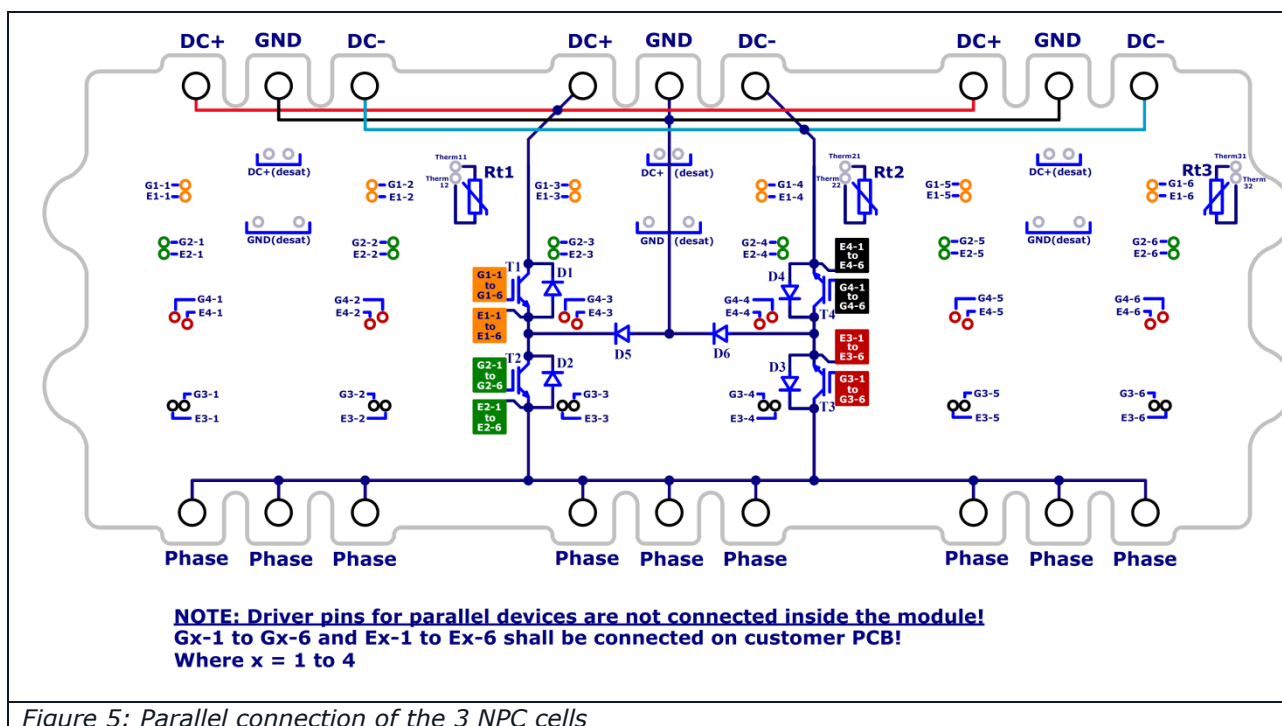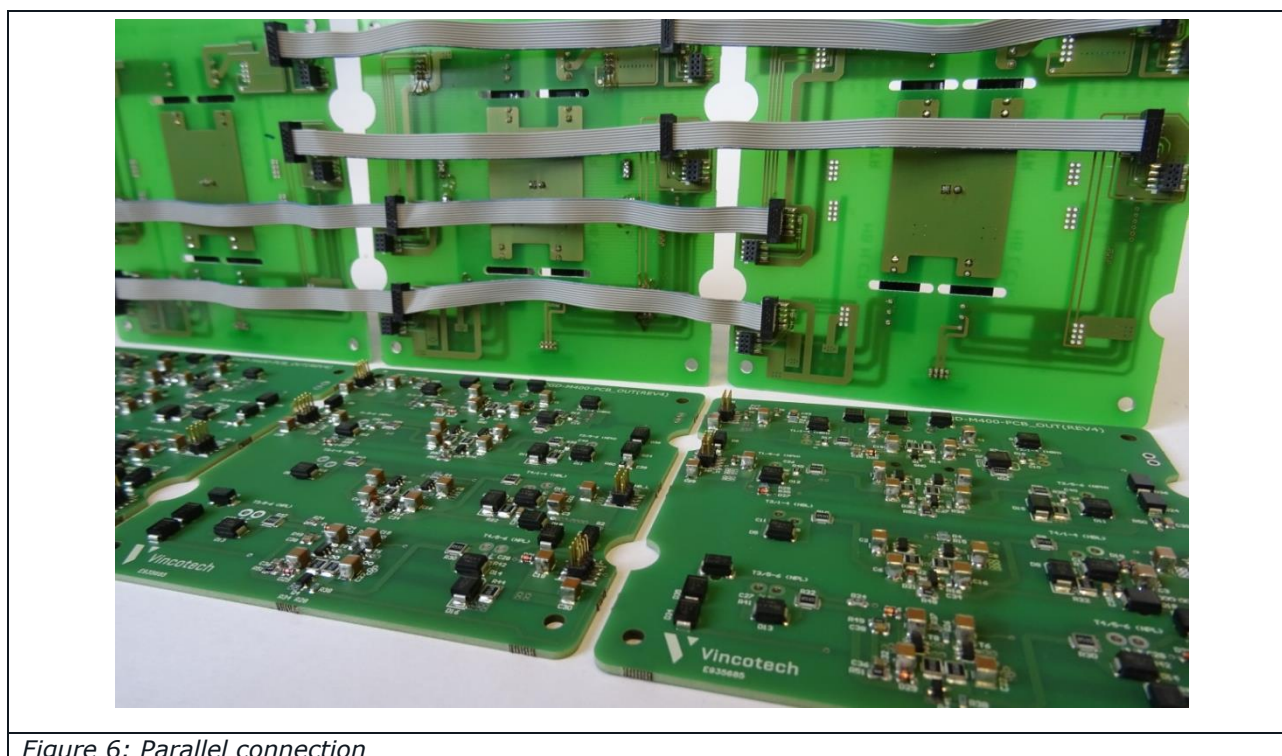l be shown in the next chapters. Premade ribbon cables are used for paralleling signal from MASTER through all three NPC cells.

For more details about the VINco X4 gate driver please visit the Vincotech web site.

4.1 Signal distribution at S-M-S gate drivers

In order to drive an L40X power module we will use a SLAVE-MASTER-SLAVE gate driver configuration. The input PWM signals are received by the CTR (vertical) cards of the MASTER gate driver. INPUT PWM signals can be transmitted to the CTR card via fiber optics. The FAULT signals transmitted by the CTR cards in opposite direction is implemented in this alternative mode as well. *Figure 7* shows the block diagram of the electrical interconnection of the SLAVE-MASTER-SLAVE gate drivers. The current booster PCB has two current boost stages that are connected in parallel to provide a sufficient gate current when necessary. The module has two gate pins, each for half of the module. A common gate resistor and separated gate resistors are used for the gates and furthermore a common emitter resistor. This way the synchronous switching of the stages can be assured.
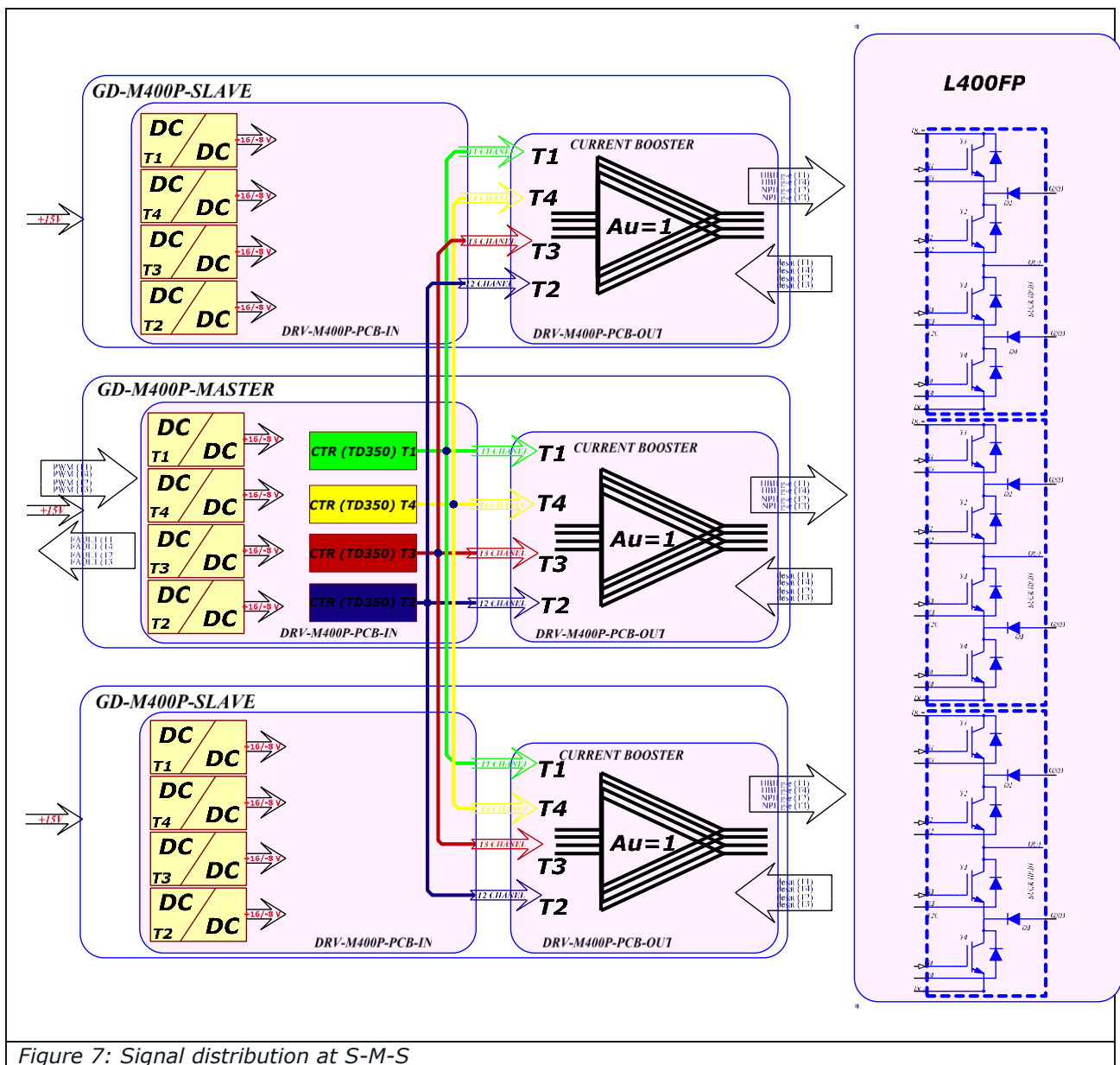
Figure 7: Signal distribution at S-M-S

At *figure 8* the parallel connection of the current boosters for one channel is illustrated.

Parallel operation of the current boosters for one channel

Figure 8: Parallel connection of the current booster
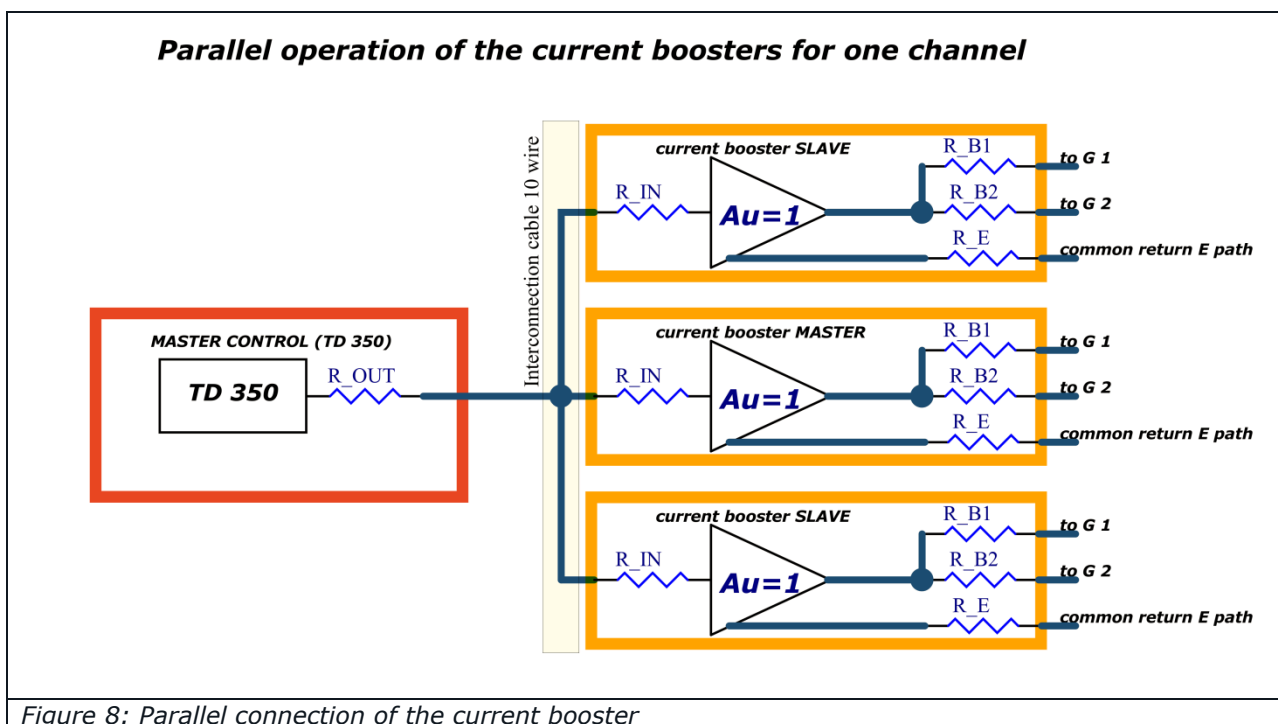
4.2 Mechanical assembly of the gate drivers

L40X power module is pin compatible with M40X. Gate signals desaturation sensing points and NTC outputs are located at same x-y coordinates. *Figure 9* shows the L40X module with its S-M-S gate drivers

Figure 9: L40X with S-M-S gate driver

Interconnection of the gate drivers from bottom view:

Figure 10: S-M-S interconnection at IN PCB level

4.3 Interconnection cable for S-M-S operation

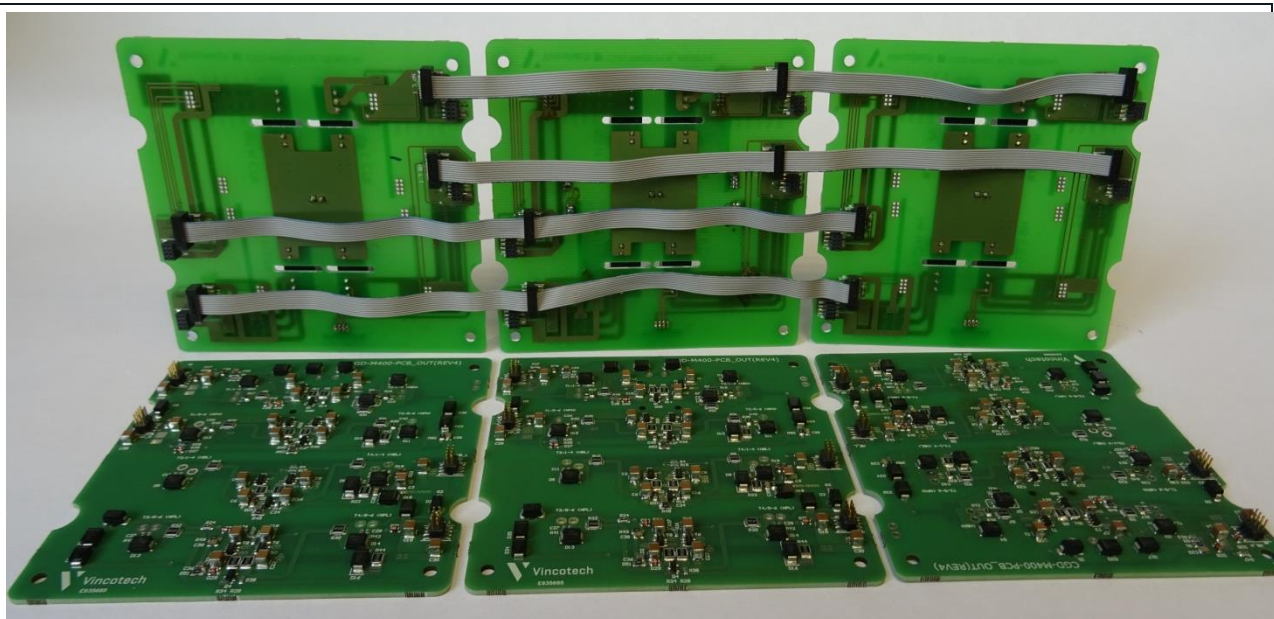| Connector: HB H ; HB L ; NP H ; NP L					
Pin	Signal HB H	Signal NP H	Signal NP L	Signal HB L	Comment
1	desat	desat	desat	desat	Desaturation protection
2	+16 V	+16 V	+16 V	+16 V	Positive supply
3	out high	out high	out high	out high	Signal for turn on/off
4	V clamp	V clamp	V clamp	V clamp	Active voltage clamp
5	-8 V	-8 V	-8 V	-8 V	Negative supply
6	clamp	clamp	clamp	clamp	Miller clamping
7	GND	GND	GND	GND	Ground
8	n.c.	n.c.	n.c.	NTC	not connected / NTC
Table 2: Signals on Interconnection cables					

Signal distribution between the MASTER and SLAVEs is assured by 4 interconnection cables, with 10 wires each. Although the supply voltages are paralleled (16V , GND, -8V) , so if one DC/DC converter is supplied not only the supplied gate driver is functional, also the others are powered up, it's very important all the gate drivers must be externally supplied by +15V at P17 to avoid the overload of the DC/DC converters of the IN PCB card.
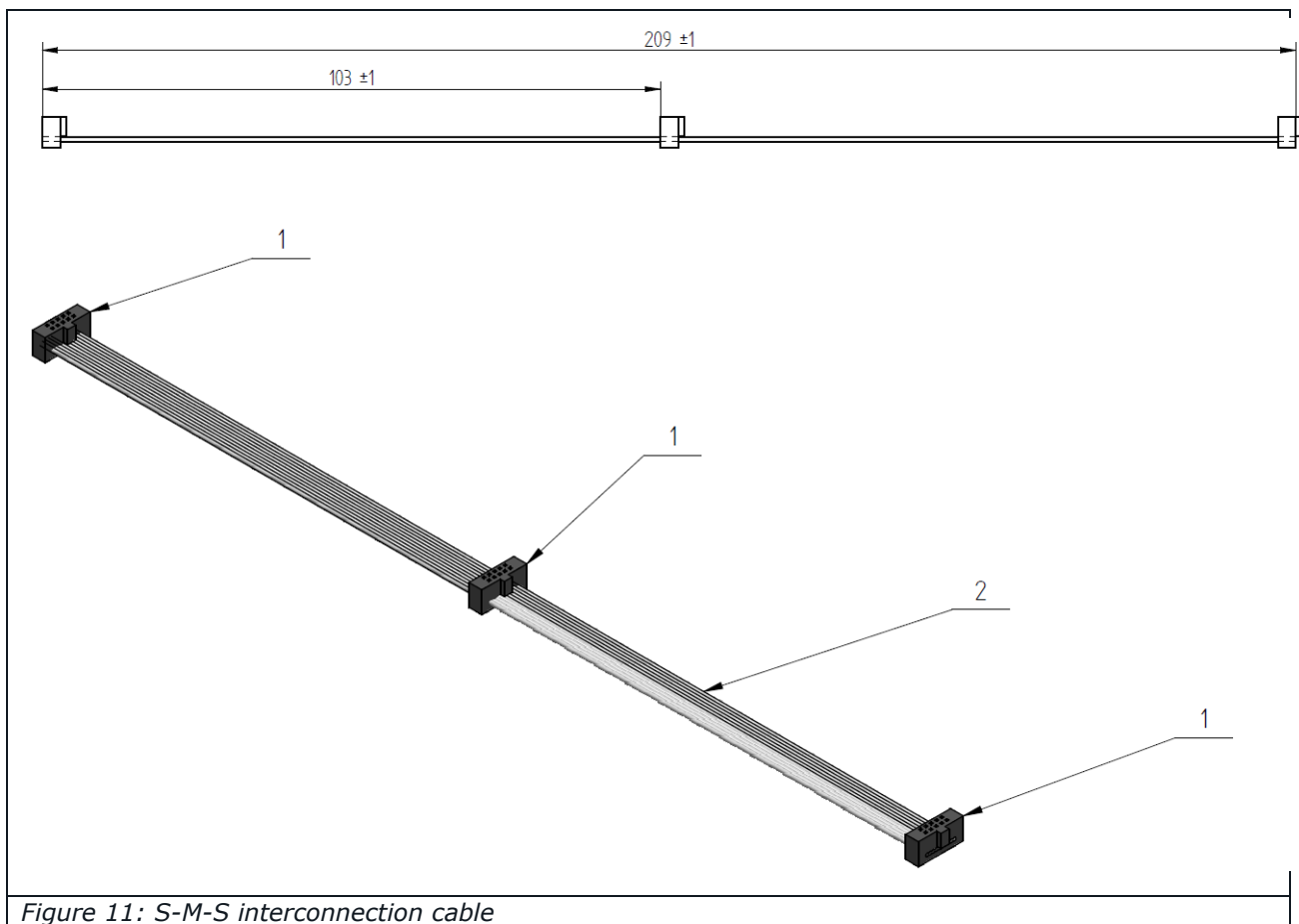
Figure 11: S-M-S interconnection cable

Figure 11 shows the 10 wired interconnection cables. The total length of the cable is 209+/-1 mm, with a symmetrical assembling of the connectors.

4.4 Ordering numbers

Vincotech offer the L40X gate driver solution as a ready to use kit, including the input DC connector (+15V) screws and standoffs for assembling. *Table 3* shows the ordering numbers for a S-M-S gate driver suitable for L40X.

Ordering number	BOM	Quantity	Obs.
GD-L40X-KIT	GD-M400-Master	1	including input power connector, fiber optics connector, screws and standoffs
	GD-M400-Slave	2	including input power connector, screws and standoffs
	GD-L400-SMS-CONN	4	

Table 3: Ordering numbers for an L40X gate driver

5   Conclusion

With a proper parallel connection of the current boosters, the current capability of the gate driver can be increased in order to serve the higher current rated Vincotech power modules. Meanwhile the equal current sharing between the paralleled power modules is kept. To maintain this balanced current, the customer has to pay a special attention to a symmetrical connection of the input-output wiring.
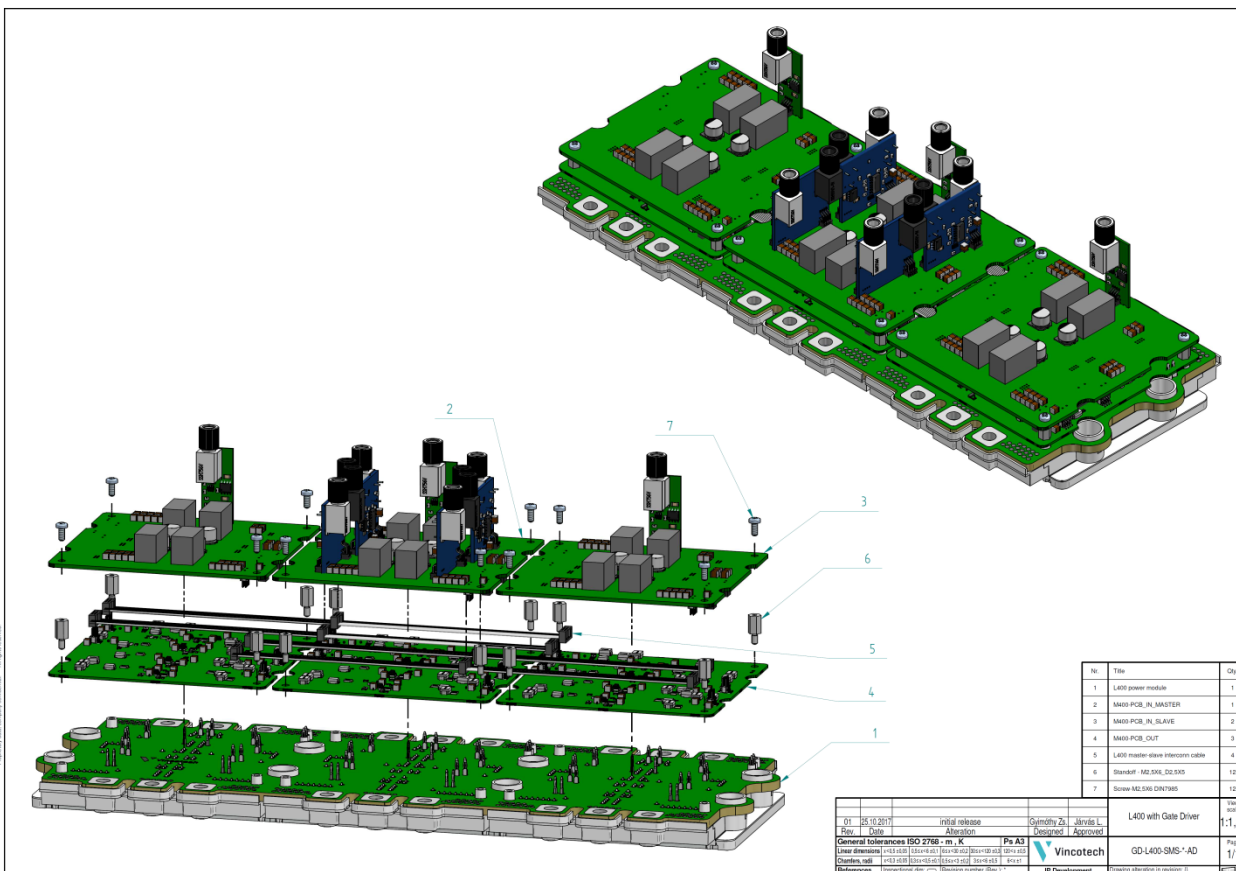
Figure 12: Mechanical assembly of the S-M-S gate driver system

The figure contains the following parts list table:

Nr.	Title	Qty.
1	L400 power module	1
2	M400-PCB_IN_MASTER	1
3	M400-PCB_IN_SLAVE	2
4	M400-PCB_OUT	3
5	L400 master-slave interconn cable	4
6	Standoff - M2.5X6_D2.5X5	12
7	Screw-M2.5X6 DIN7985	12

| 01 | 25.10.2017 | initial release | Gyimóthy Zs. | Járvás L. | L400 with Gate Driver | View scale |
| Rev. | Date | Alteration | Designed | Approved | | 1:1,33 |

General tolerances ISO 2768 - m , K   Ps A3
Linear dimensions
Chamfers, radii
References

GD-L400-SMS-*-AD

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IP Development