

Dupline Safe Design and Installation Guide



This document gives the installer / designer different tools, that makes it possible to perform an accurate quotation and correct design of a Dupline Safe Installation. At the same time the document gives an overview of different Dupline Safe solutions for the installer/designer.

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Dupline Safe Design and Installation Guide

Introduction:

The Dupline Safe system is a 2 wire bus system based on Dupline. The Dupline Safe transmitters are placed along e.g. a conveyor and transmit the Dupline Safe signal back to the Dupline Safe Relay module. If a Safe situation occurs the Dupline Safe Relay releases and disconnects e.g. the motor to the Conveyor belt. At the same time Dupline Safe gateways can transmit the status to a PLC. When the situation has been solved the system can be restarted and the conveyor belt can start up again.

In the following, the design and installation guide will explain the Dupline Safe principles, the products, calculations and go through different installation examples that can be used as templates for installers in future installations.

Hardware:

The Dupline Safe Installation basically consists of 3 modules and a programming device:

- | | |
|--------------------|-------------------------------|
| 1* SD2DUG24 | - Dupline Channel Generator |
| 1* GS7510 21xx | - Dupline Safe Transmitter |
| 1* GS3830 0143 230 | - Dupline Safe Relay |
| 1* GS7380 0080 | - Programming and test device |

Dupline Channel Generator Module (SD2DUG24):

The Generator provides the Dupline bus with power to the bus-powered modules and synchronizes the transmission signal for the entire system of Dupline Modules. The Generator generates a 1KHz pulse train on 8, 2 V that is available on the entire bus. The technic used, makes the bus very robust and very noise immune. This module is a standard Dupline channel generator and does not need a special approval to be used in the Dupline Safe System. Please refer to the section: [Safety Approvals](#)

The SD2DUG24 is powered by 10-30 VDC.

The module has 3 LEDS on the front cover:

- | | |
|-------------|-----------------------------|
| Green LED: | Power on the module |
| Yellow LED: | Dupline Bus running |
| Yellow LED: | RS485 communication running |



It generates 8, 16, 24, 32, 40, 48, 56, 64, 96 and 128 channels and it is fully programmable via a dedicated software that is free downloadable from Carlo Gavazzi productselection.net on the SD2DUG24 page. The DUG software includes the Wizard procedures to substitute the old G34900000xxx and G34960005xxx Dupline® Master channel generators.

See the user manual for any further details.

Note: The number of addresses selected must have the same number as the GS3830 0143 230. See section: [“Programming the Dupline Safe Relay Module \(DSRM\)”](#).

Dupline Safe Transmitter (GS75102101):

The Dupline Safe Transmitter is a single channel bus-powered input module. It has potential free contacts and small dimension IP67 housing for de-central installation. Very low current consumption on 1mA.

The module has a cable with 6 wires.

2 wires for the contact (Pink and White)

2 wires for the Dupline bus (Brown and Grey)

2 wires for programming (Green and Yellow). The 2 Dupline wires are also used for programming

Use the adapter ADAPT 7380 together with programmer device GS7380 0080 when programming the Dupline Safe Transmitters

Note:

When the programming has ended the green and yellow wires must be connected to D- (grey wire) to avoid noise in the module.

Note:

Short-circuit over the input leads are dangerous, but according to ISO/EN 13849-1 PL e this type of fault can be excluded if the safety input device is mounted in the same enclosure or cabinet as the safety switch.

Other available Dupline Safe Transmitters:

- GS75102101-1
- GS75102192 and
- GS75102192-1



Dupline Safe Relay Module (GS 3830 0143 230):

The Dupline Safe Relay Output Module can monitor up to 63 Dupline Safe Input Modules. The Safe Relay module does not occupy any Dupline addresses and it is possible to connect several Safe Relay Modules to the same Dupline bus. When a Dupline Safe Input Module input contacts opens on the monitored channel or if the Dupline bus is interrupted, the output on the Relay Module go to safety state (Contact opens).

The GS 3830 0143 230 is powered by 115VAC or 230VAC

Dupline bus connection for D+ and D-

A manual restart option. When this is used it is needed to select this option in the programming also.



The Status of the output relay can be read by a NPN transistor to light up e.g. a LED

Finally the Module has two independent outputs NO Safety Relays.

Dupline Programming Unit (GS73800080):

The Configuration and Test Unit GS73800080 is needed in all circumstances with the rest of the Dupline Safe installation. It is used to program all the Dupline Safe Transmitters and the Dupline Safe Relay Module(s)

When programming the Dupline Safe Transmitters GS75102101 the adaptor ADAPT7380 is needed.

The Configuration Unit is supplied with an internal 9V battery. This means that

the Safety Modules does not need power during programming. Also for

Safety reasons, no modules can be programmed by the Configuration Unit

when there is power on the module.



The Configuration Unit is also a powerful test and maintenance Unit. Connecting the grips directly on the Dupline bus, it is possible to read the status on the Safety Input Transmitters or even to simulate the presence of a transmitter by pressing the selected Dupline Address.

The Configuration Unit has two connections. RJ12 for programming mode or mini jack for GTU8 mode. It has 12 tactile keys where there are 8 channel keys and 4 command keys.

There is an additional programming Unit named GS73800081 that is PC based. The two programmer's functions are identical but the GS7380 0080 is more portable.

Safety Approvals:

The Dupline Safe System has the following approvals:

- IEC 61508, parts 1 - 7: 2010
- EN 62061:2005 + AC:2010 + A1:2013 + A2:2015
- EN ISO 13849-1:2015
- IEC 61131-2:2017
- EN 50178:1997
- EN 61326-3-1:2017
- TÜV Rhineland Group
- cULus

This means that not all products in the Dupline Safe System have the same approvals. The only products that need a complete set of the above approvals are the:

- Dupline Safe Input Module GS75102101
- Dupline Safe Input Module GS75102101-1
- Dupline Safe Input Module GS75102192
- Dupline Safe Input Module GS75102192-1
- Dupline Safe Output Module GS38300143230

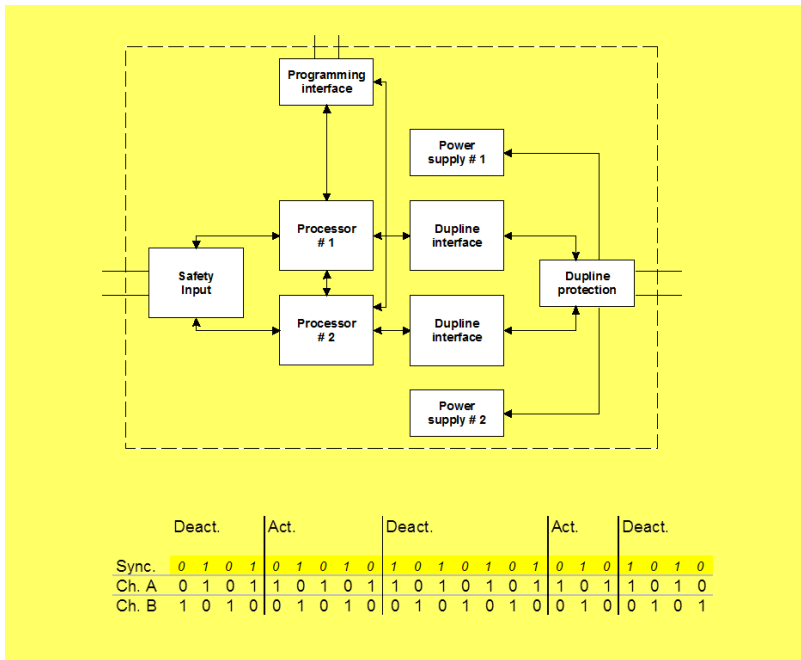
Other Modules in the Dupline Safe System are approved by TÜV to be used together with Dupline Safe. Those modules are:

- Dupline Safe /Optical Fiber Converters GS3492 0000 xxx and GS3493 0000 xxx
- Dupline Safe Repeater GS3892 0000 xxx
- Dupline Safe Profibus Gateway GS3891 0125 230
- Dupline Safe Modbus Gateway GSTI50
- Dupline Channel Generator SD2DUG24
- Dupline Safe Programmer GS7380 0080
- Dupline Safe Programmer GS7380 0081

Dupline Safe Communication:

There is basically no difference in installation or handling between Standard Dupline and Dupline Safe.

The only major difference is the Communication Concept for Dupline Safe.



The synchronization channel is toggling every Dupline cycle (controlled by safety output module). The status of each input is transmitted on 2 different Dupline channels. The transmission is dynamic with the bits toggling every Dupline cycle. When the input contact is closed, channel 1 follows the sync channel, channel 2 is reverse. When the input contact is open it is in the opposite mode.

In general, it means that each input Module GS7510 2101 uses 2 Dupline channels e.g. A3/A4. The Dupline bus uses a channel for Synchronizing (A1 or A2). When the Dupline Safe Relay Module recognize an error on the Dupline bus or a Dupline Safe Input Module that has changes status to “Open”, the Relay Module will go to a safety status and open the Relay Output contacts.

Time Delay on Dupline Safe installations:

In all kind of electronic installations there will be some kind of delay from the inputs to the outputs. In the following we will go through the time delays on the products in the Dupline Safe installations.

Dupline Safe transmitter GS7510 xxxx-x:

The Dupline Safe Transmitters (DST) GS7510 xxxx-x are all semiconductors and have a power on delay <5 Sec.

When the power is steady “ON”, the transmitters have no measurable delays from the activation on the input has taken place until the information is on the Dupline bus, so this will not be taken into consideration.

Dupline Safe Relay Module GS3830 0143 230:

The Dupline Safe Relay Module (DSRM) GS3830 0143 xxx is different as this has mechanical relays build in. The module has a power “ON” delay on 10 Sec.

The reaction time for the total Dupline® safety-loop depends of the number of Dupline® channels. The response time can be calculated as:

Reaction time on relay release (worst-case): $2 \times \text{Number of Dupline® channels} + 40$ [ms]

Note: Reaction time is for the total Dupline® safety loop; from a safety input goes to non-safe state until the output relay is released. Reaction time on relay activate (worst-case): $4 \times \text{Number of Dupline® channels} + 80$ [ms]

Note: Reaction time is for the total Dupline® safety loop; from a safety input goes to safe state until the output relay is activated.

Max delays in Dupline Safe:

We state that the general response time is max 300ms.

“From input contact of safety input module opens to safety relay releases”.

We state that the general response time is max 600 ms.

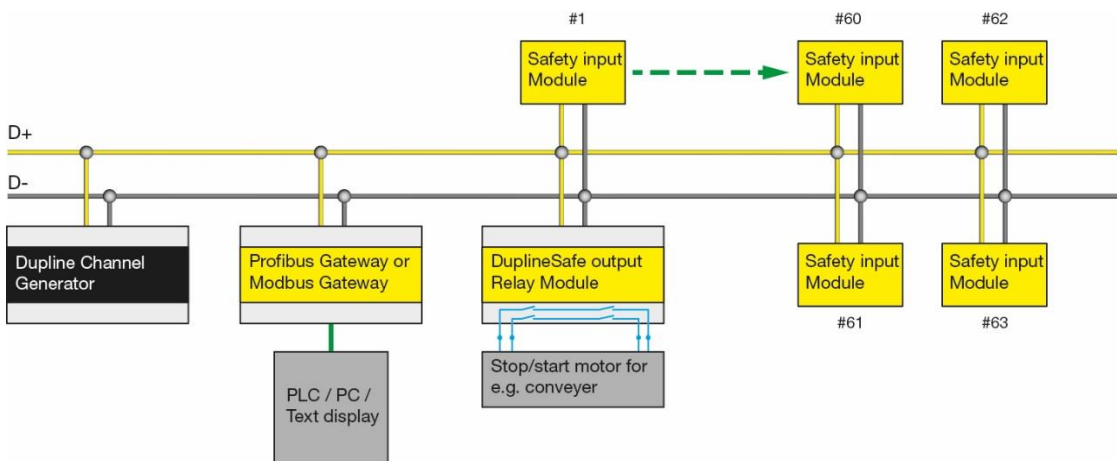
“From input contact of safety input module closes to safety relay activates”.

This statement is in installation without the use of repeaters.

Common to both repeaters (GS3892 0000 and GS3493 0000) is the delay on the transmissions time. 1mSec from primary to secondary and one Dupline cycle (136mmSec) from secondary to primary side.

Schematic Dupline Safe Solution (Basic):

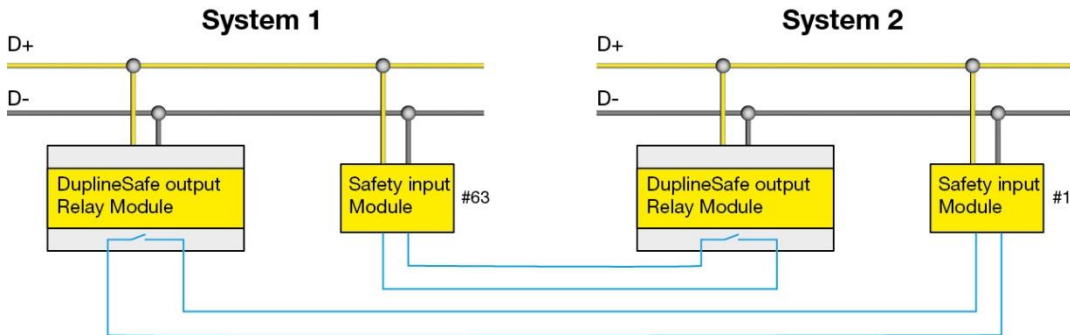
Fig. 1A



The drawing shows a schematic view of an installation using 63 Dupline Safe Input modules, Gateway for external communication (In Dupline Safe it is only possible to read values and not to write). A standard Channel Generator is used and there is one Dupline Safe Output Relay Module to stop the motor on the conveyer if an emergency situation occurs. A Basic solution as the drawing on Fig. 1A can be extended if needed. The Fig. 2A shows an extended version where we have more Dupline Safe Input Modules.

Dupline Safe with more inputs:

Fig. 2A



So, the drawing shows a section of system 1 and system 2. In the example the two systems are equal to drawing in fig. 1A. The way we recommend to extend the conveyer with more Dupline Safe Inputs is the following:

Input 63 on system 1 is only connected to the contacts on the Dupline Safe Relay Module on system 2. This relay module only purpose is to monitor all the Dupline Safe Input Modules on System 2 from 2 to 63. When one of the monitored inputs on System 2 detects an open contact, the information will be transferred to the Input 63 on system 1. The Dupline Safe Relay that is connected to the motor, monitor Input 63. In that way the complete conveyer is monitored in this direction.

To cover the conveyer in both directions we need to do the exact same exercise with Input 1 on system 2.

It is possible to extend the Conveyer with more and more inputs if the rules mentioned in Section "Schematic Dupline Safe Solution (More inputs)" are obeyed.

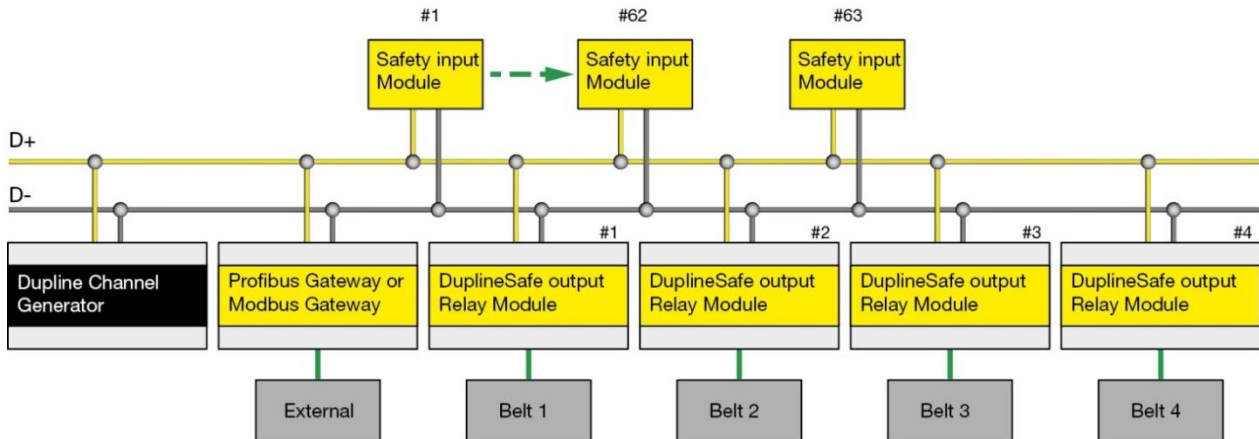
Note: The two systems have an independent Dupline Channel Generator and the Dupline bus must never be grounded or connected to other Dupline busses

Dupline Safe with more Outputs:

There can be many reasons to use several Dupline Safe Output Relay Modules in a Safety Installation.

One reason could be many independent conveyer belts using their own motor.

Fig. 3A



E.g. a system with 4 belts. All the belts are supplying one another with rubbles. Then suddenly belt 3 stops by an emergency stop.

If the system is correctly designed belt 1, 2 and 3 will stop but belt 4 will continue running until it is manually stopped.

The Dupline Safe Relay 1 is monitoring the Dupline Safe Input Modules on belt 1, 2, 3 and 4. So if something happens, then motor on Belt 1 will always stop.

The Dupline Safe Relay 2 is monitoring the Dupline Safe Input Modules on belt 2, 3 and 4. So if something happens on these belts, then motor on Belt 1 and 2 will always stop.

The Dupline Safe Relay 3 is monitoring the Dupline Safe Input Modules on belt 3 and 4. So if something happens then motor on Belt 1, 2 and 3 will always stop.

The Dupline Safe Relay 4 is monitoring the Dupline Safe Input Modules on belt 4. So if something happens then motor on Belt 1, 2, 3 and 4 will always stop.

Miscellaneous Repeaters:

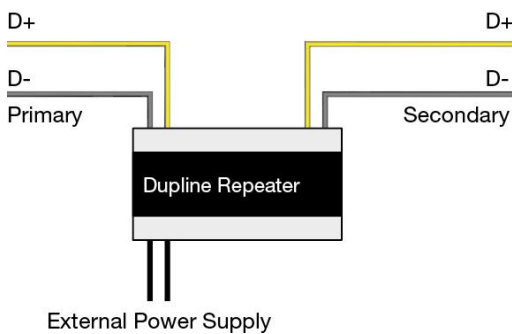
One of the major advantages in Dupline is the long distances without the need of repeating the Dupline signal. Basically the Dupline bus can transmit up to 5Km in a Dupline Safe Installation without repeating the signal.

Many installations with Dupline Safe, tells us that the need of repeating Dupline Safe is very much needed anyway. So a solution could be using the:

- Dupline Safe Repeater GS3892 0000 xxx or the
- Dupline Safe /Optical Fibre Converters GS3492 0000 xxx and GS3493 0000 xxx

The basic function of the GS3892 0000 xxx is simply to repeat the Dupline signal and thereby increase the distance in a Dupline Safe network.

Fig. 4A



When using a repeater, it is important that the designer of the installation has made a proper calculation where on the line, it is necessary to insert a repeater, in a Dupline Safe Installation. Please read more about calculation under the section: "Calculation".

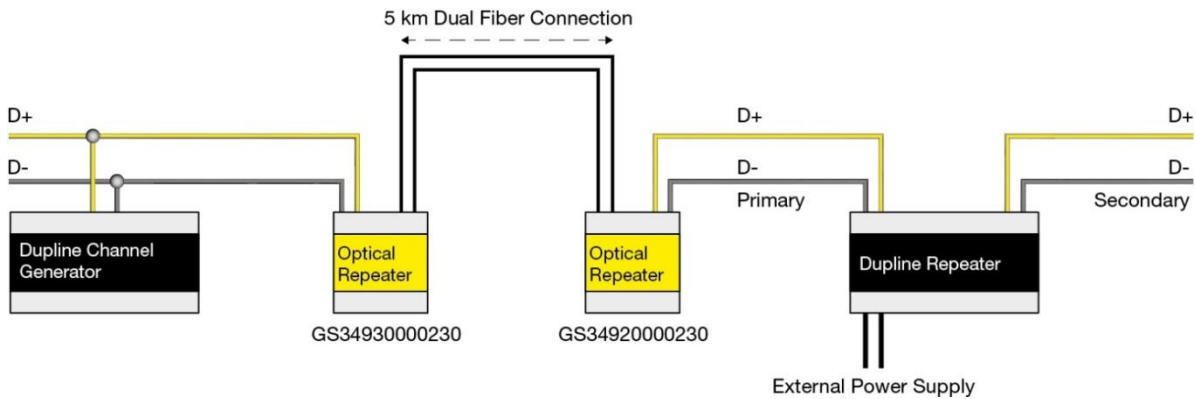
When the calculation has been made it is simply to install the repeater according to drawing fig. 4A.

The primary side is pointing towards the Channel Generator. On the secondary side the system now has extra 50mA current for extra cable and modules. The repeater needs an external power supply such as 24, 115 or 230VAC.

If the system needs to have an extra enlargement it is possible to install extra repeaters GS3892 0000 xxx to meet this. Before installing extra repeaters, the designer needs to make a new calculation on the extra repeaters.

The basic function of the GS3492 0000 / GS3493 0000 is simply to repeat the Dupline signal and thereby increase the distance in a Dupline Safe network.

Fig. 5A



This repeater converts the Dupline signal for transmission on optical multimode fibre pairs. Up to 5Km optical transmission distance can be achieved. The same precautions as for the repeater GS3892 0000 must be taken into consideration. Please more about calculation under the section: Calculation.

The GS3493 0000 is connected to the primary system where the Dupline Channel Generator is connected. After maximum 5Km the other part of the optical converter GS3492 0000 is connected. The GS3492 0000 have a Channel Generator built in so there is no need for a separate Channel Generator.

The GS3492 0000 have 40mA for extra cables and modules. The repeater needs an external power supply such as 24, 115 or 230VAC.

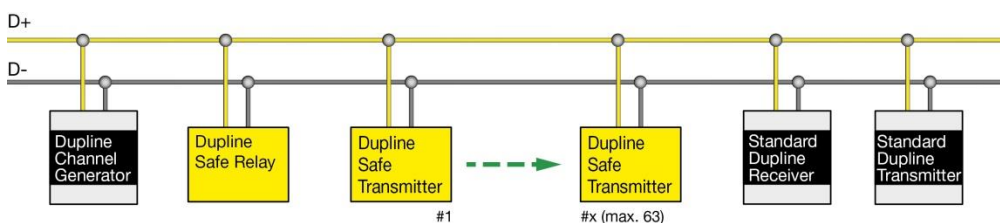
If the system needs to have an extra enlargement it is possible to install extra optical repeaters to meet this. Before installing extra repeaters the designer needs to make a new calculation on the extra repeaters.

Common to both repeaters is the delay on the transmissions time. 1mSec from primary to secondary and one Dupline cycle (136mSec) from secondary to primary side.

Combining Dupline Safe and Standard Dupline:

If needed, it is possible to combine Dupline Safe modules and Standard Dupline modules using the same Dupline bus.

Fig. 6A



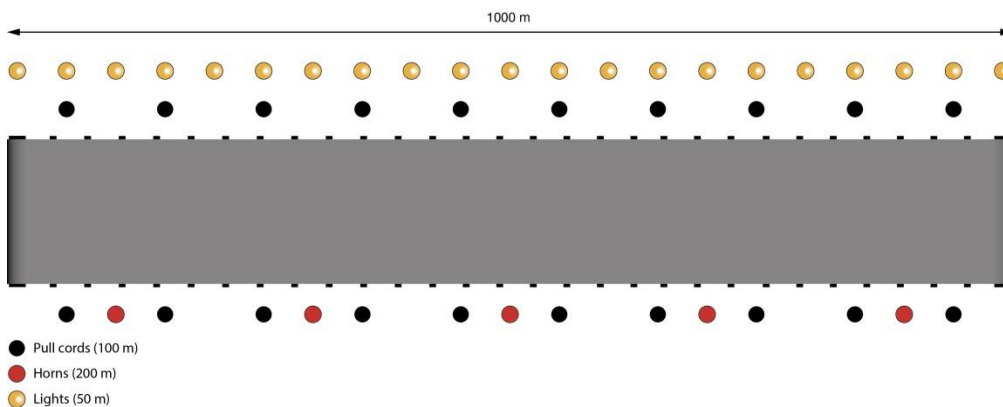
The Dupline principles are the same but it is essential to remember to separate Dupline Safe and Standard Dupline addressing from each other. The reason to combine both types could be e.g. to control light / alarms on a conveyer and at the same time monitor the Safety Pull cords.

Example: 1000 Meter conveyer with 20 Dupline Safe Transmitters (DFT).

At each 100 meter we have a Pull cord on each side.

There is a horn placed at every 200 meter and there are lights at every 50 metres.

Fig. 7A



Addressing the modules must be in order and it is recommended to have Dupline Safe at the beginning at the addressing range starting from A3 and forward. A1 and A2 are used for Dupline Safe sync / internal use and cannot be redefined for other use.

The Dupline Safe Modules are then programmed from A3 to F2 = 20 modules.

The installer can now decide to start programming standard Dupline from F3 and forward but we recommend having a gap between the Dupline Safe and Standard Dupline if the installer at some time decides to introduce a new DST in the system.

The horns and the light can then be controlled by standard Dupline Receiver Modules such as G3430 5545 or the de-central relay G8830 1143. The relay modules can be controlled by Dupline Standard Transmitters e.g. G3410 5501 or the de-central transmitter G5010 xx06 / G8810 2201.

Else the installer can use PC / PLC to control the Dupline Standard Modules using Gateways. The Dupline Safe Profibus Gateway GS3891 0125 230 can work with both Standard and Safety Dupline, the Dupline Safe Profinet Gateway GS33910060800 can work with both Standard and Safety Dupline.

Miscellaneous Gateways:

Many Safe systems needs to monitor the transmitters independently so the operator of the e.g. conveyer knows exactly where the transmitter/pull cord has been activated. A conveyer belt can easily be 10 to 20 Km long, so it is essential to know the exact location of the faulty /activated pull cord.

The Dupline Safe System offers 3 kinds of Safety Gateways. The Modbus RTU Gateway GSTI50, the Profibus Gateway GS38910125230 and the Profinet Gateway GS33910060800.

The GSTI50 is a cost effective solution and gives the installer the option to read the 63 Dupline Safe Inputs. By using the dipswitch 1, the installer can select 2 device addresses.

The GSTI50 is a Modbus RTU slave with a RS485 using 25-pole SUB-D.

Using dipswitch 2 it is possible to switch between baud rate 9600 and 19200.



The GS3891 0125 230 is a passive Profibus Gateway without Channel Generator.

Several Gateways can be connected to the same Dupline network with unique ID numbers. From address 02 to 99 can be selected.

All 63 Dupline Safe Inputs can be read by the Gateway. The Interface is an RS485 Profibus -DP standard with automatic baud rate detection.



The GS33910060800 is a Profinet gateway and can work together with up to 7 GS33900000800 channel generators. Up to 61 Dupline Safe Inputs can be connected to one channel generator: one Gateway can collect up to 427 Dupline Safe Inputs.

Interface is Ethernet Profinet-DP standard.

In most installations we have the Profibus Gateway solution. This Gateway has more options and it is also possible to have 98 unique Gateways connected on the same system. The programming in Profibus is also more forward compared to Modbus RTU.

Only the Profibus GS3891 0125 and Profinet Gateways GS33910060800 can read and write STANDARD Dupline signals. So if the installer combine both Standard and Dupline Safe modules it is possible to use these gateways to read Standard Dupline Transmitters and control Standard Dupline Receiver modules.

The GSTI50 can only read Dupline Safe signals.

Programming the Dupline Safe Modules:

Basically a PC is not needed when programming the Dupline Safe Modules. CG offers a Handheld Configuration Unit GS7380 0080 but we also offer the PC solution using the GS7380 0081. We will focus on the Handheld Configuration Unit GS7380 0080.

It is a very good idea to pre-program the DSTs before installation. The DSTs does not need external power because the Handheld Configuration Unit has an internal 9V AA battery. It is also saving installation time to make a pre-programming.

Note: Caused by safety reasons, it is not possible to program transmitters if the transmitters are powered by the Dupline bus. Only dismounted transmitters can be programmed.



Dupline Safe Transmitter (DST):

Connect the GS7380 0080 to the ADAPT 7380

Connect 4 wires on the GS7510 2101 to the ADAPT 7380 using the correct colours: Brown, Grey, Yellow and Green.

Press the “Read/On” on the configuration Unit. The Unit responds with

```
CONFIG UNIT  
BEGIN?
```

Press “Yes” and the Unit respond: (Default settings on all Dupline Safe Transmitters)

```
TRANSMIT: SYNC:  
A3 A4 A1
```

The installer can now select the correct Dupline address pair and the Sync address as well. Use Transmit addresses from A3/A4 to P7/P8 and be sure not to program more transmitters with the same addresses. The Dupline Safe System will fail when started if the transmitters have a double programming.

The Sync address must be the same address on **ALL** DST and Dupline Safe Relay Modules (DSRM). It is possible to select between A1 and A2

When the Sync address has been selected then Press "Yes"

```
SEND DATA TO
UNIT      YES/NO
```

Press "Yes" to confirm the programming or "No" to abort

Continue with the next Transmitter. Write e.g. the address on the flip side of the transmitter with a permanent pen.

Dupline Safe Relay Module (DSRM):

Basically a PC is not need when programming the Dupline Safe Modules. CG offers a Handheld Configuration Unit GS7380 0080 but we also offer the PC solution using the GS7380 0081. We will focus on the Handheld Configuration Unit GS7380 0080.

Caused by Safety reasons, the Configuration of the GS3830 0143 230 Dupline Safe Relay Module (DSRM) can only be done, when the power to the module, has been turned off.

Connect the Configuration Unit to the RJ12 connector on the front of the GS3830 0143 230.

Note: The LEDs on the front of the GS3830 0143 blinks one by one all the time when connected.

Press "Read/On" on the Unit. The Unit respond with:

```
CONFIG UNIT
      BEGIN?
```

Press "Yes" and the Unit reads the configuration in the GS3830 0143 230

```
NO OF CHANNELS :
      128
```

"No of channels" must be the same number as for the rotary switch on the Dupline Channel Generator G3490 0000 xxx. See section "Dupline Channel Generator Module (G3490 0000 230)". Default is 128 and it is recommendable to use this setting.


```
UNITS ON GRP. B
12 34 56 78
```

“Units on Grp. X” is the addresses on the transmitters this particular DSRM are monitoring. When the addresses are highlighted they are selected and are monitored. Select the addresses by the tactical keys 1-8. Use the “Yes” and “No” key to select the Dupline group from A to P.

```
SYNC CHANNEL :
                A1
```

The sync channel must be the same for all connected safety transmitters and safe relay modules. Select between A1 and A2.

```
GENERATE SYNC
1: YES 2: NO (YES)
```

“Generate Sync”. There can be many DSRM installed but only one’ module can generate the sync signal. If two or more generates the sync the Dupline Safe System fail and will not work correctly.

```
AUTO RESTART
1: YES 2: NO (NO )
```

“Auto Restart”. The DSRM have an option where it is possible to select between auto start and manual start. If auto is selected the system enables immediately after the system has been normalized.

If manual is selected, the operator must manually activate a pushbutton to start the system after it has been normalized.

```
SEND DATA TO
UNIT          YES/NO
```

Press “Yes” to confirm the programming or “No” to abort.

Reconnect power to the GS3830 0143 230 and it is fully operational again.

Cable:

Carlo Gavazzi recommends installers to use a 2*1,5 twisted, not shielded cables in all Dupline Safe Installations. The cable should always have a low capacitance and it is preferable if the cable capacitance is < 80 nF/Km. Only in very seldom circumstances shielded cable is recommended. This is where the cable is installed near consumers with more than 1kW.

Cable Specifications:

- Long distances: 1.5mm² The cables resistance is 12 ohm/ Km
- Medium distances: 0.8-1.0mm² The cables resistance is 18 ohm/ Km
- Short distances : 0.35mm² The cables resistance is 50 ohm/ Km

Cable installation rules:

- Never connect Dupline Common (D-) to Ground
- Use DT01 termination unit for total distances > 1.5 Km
- Use only shielded cable, when installed near to consumers with more than 1kW
- Do not connect multi-wire cables in parallel to increase the cross-section
- There are no restrictions on the routing of the Dupline cable. Line-, star-, ring- or combination-topologies can be implemented
- A branch can be made at any point in the system, and there is no restriction on the length except for the limitation in the total transmission distance

Calculation:

Before making any installation or ordering cables, it is important to make a proper calculation to see if the Dupline Safe installation will work under the predicted conditions.

Hereunder we will show basic calculation on some specific examples and also calculation that can be used as templates for installers.

Electrical Facts:

Voltage drop on the far end of a Dupline bus must never exceed 3,5V

The total length for the common mode signal is twice the length of the cable

Using 1,5mm² cable, the cable resistance is 12 ohm/km

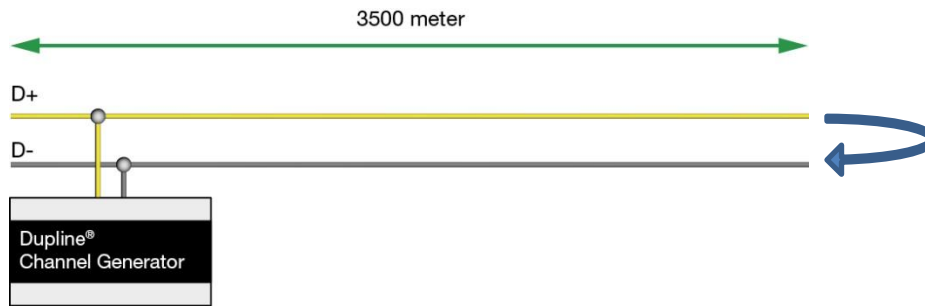
Template 1(Known distance):

If the distance between Dupline Channel Generator to the last DST is 3500 meter, the total length for the common mode signal is 2* 3500 = 7000 meter. The signal has to travel from generator to the end of the line and back to the generator again. This is a fact in all Dupline Installations.

The total cable resistance in this example is 12*7= 84 Ohm

The total available current we have left to the DST is: Voltage drop/Total Resistance= 3.5/84= **41mA**

Fig.9A



The 41mA can be used to supply the DST. Each DST uses 1mA, so the installer can install maximum 41 GS7510 2101 in this example. A termination unit DT01 must be installed at the far end of the line to prevent reflections in the cable.

If the installer needs to install more DST beside the 41 modules, please go to section: “Template 2(Known distance with many DST)”

If the installer needs to increase the length of the cable, please go to section: “Template 3(Using repeater(s))”

Template 2(Known distance with many DST):

The installer has a specific distance on 3500 meter. The same basic information as for the above template 1.

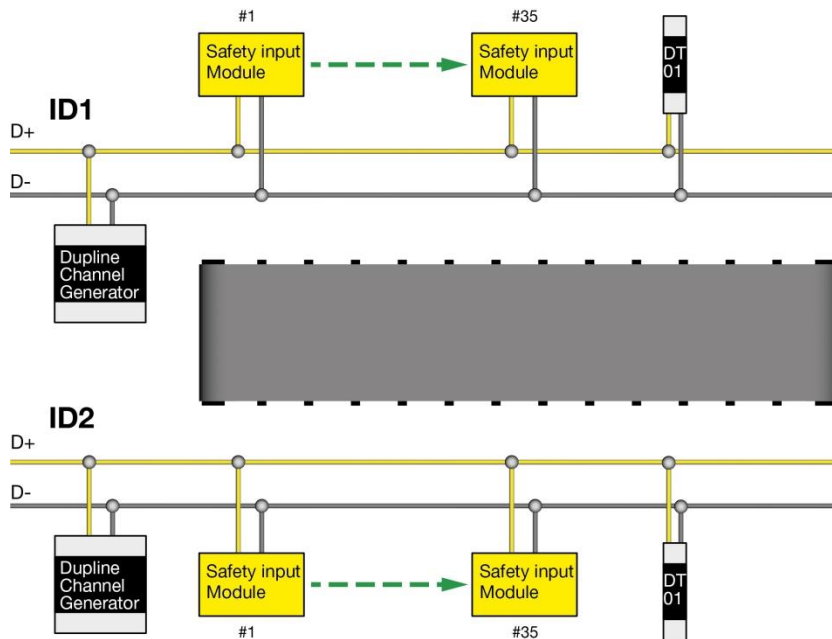
The new information is that the installer must install a DST every 100meter on both side of the conveyer.

In total the installer must install: $2*(3500/100) = 70$ DST -The situation is that we need $70-41=29$ mA to supply the rest of the 70 DST.

We have reached the limit on 63 DST on a single Dupline system, so the best thing is to split up the Dupline system into two separate networks using two Channel Generators. See fig.10A.

We know that the calculation works with 41 DST so there is no need to do a new calculation with fewer modules.

Fig.10A

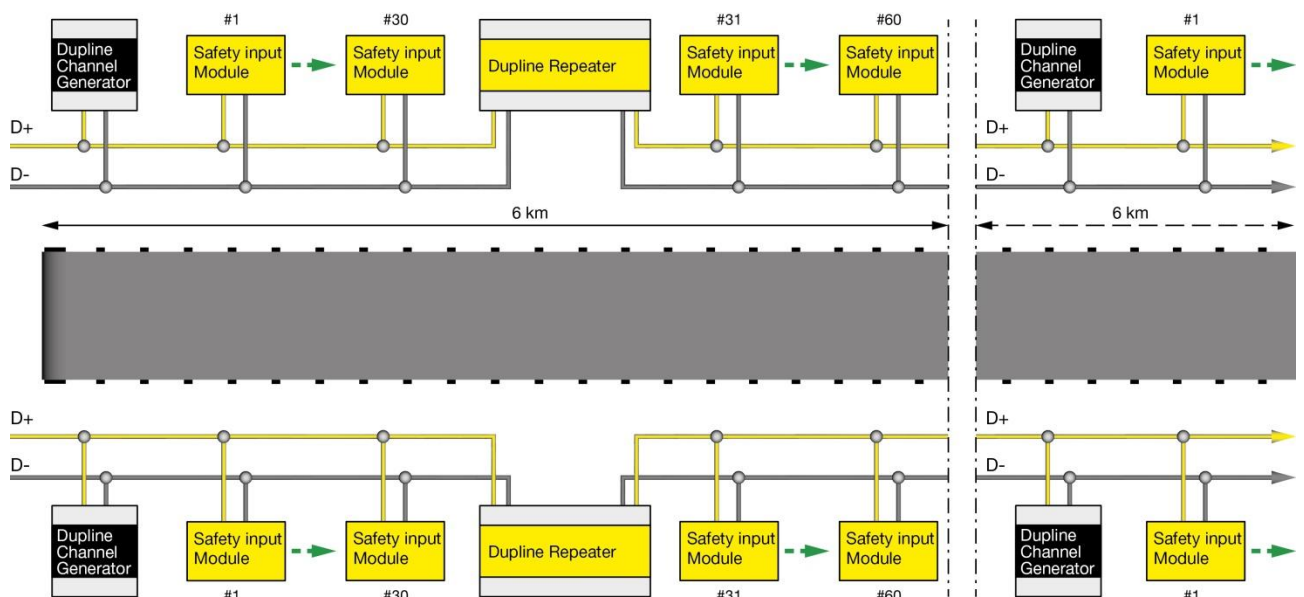


Template 3(Using repeater(s)):

The customer is going to extend the conveyer to 12 Km using DST every 100 meter on both side of the conveyer. In total the customer shall use: $2 * (12000/100) = 240$ DST.

We have exceeded the max range on 63 DST on a single network, but we can make 4 networks with each 60 DST. See fig.11A.

Fig. 11A



The 60 modules in a single network are uniformly connected to the Dupline Bus. We know we have a distance on 6000 meter for each of the 4 networks. We only need to make a firm calculation of one' of the networks because the 3 others are completely equal to the 1 network. Remember to include the DT01 at the end of each network (Sensor 60) and at primary side of the repeater (sensor 30).

Voltage drop is 3.5 V

Resistance in cable when 1.5 mm² used is 12 ohm/ Km

Total resistance is $2*6*12=144$ Ohm

Total current left to modules: $3.5/144= 24$ mA. We do not have power for all the 60 modules so we will need to put in a repeater in the system.

The Repeater GS3892 0000 230 is recommended to be installed halfway (3000 Meter) in all 4 networks.

New calculation:

Total resistance is $2*3*12= 72$ Ohm (half the resistance means we have double current)

Total current left to modules: $3.5/72= 48$ mA. In half the system (3000 meter) we have 30 DST so we have plenty of current left.

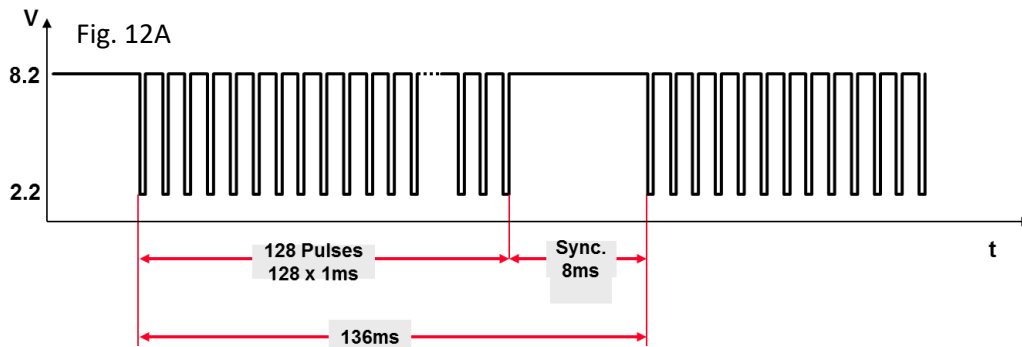
The total part list is:

240 pieces of	GS7510 2101 Dupline Safe Transmitter (DST)
4 pieces of	GS3892 0000 230 Repeater
4 pieces of	SD2DUG24 Dupline Master Channel Generator
1 pieces of	GS7380 0080 Configuration Unit
8 pieces of	DT01 termination unit
X numbers of	GS3830 0143 230 Min. 1 module must be in a Dupline Safe System (DSRM)
X numbers of selected	GSTI50 or GS3891 0125 230 or GS3891 0125 Gateways can freely be selected
X numbers of	Power supplies if DC versions are selected
24 Km of cable	2*1.5mm ² twisted, not shielded wire

Faultfinding tips:

If the Dupline Safe system of some reason does not work correctly, then check following:

- **Check LEDs on the Dupline modules are lit. Green for power and Yellow for Dupline bus signal**
 - If LEDs are off, check power supply
 - If power supply is OK then check the wiring.
 - Try e.g. to disconnect the Dupline bus and see if the Yellow LED turns “ON” on the connected modules. If the Yellow LED turns “ON”, the load on the bus is too high or the modules are defect
- **Check the Dupline bus wiring. In a long installation a bad wiring can cause randomly faults**
 - Check the cabinets for bad connections or water penetration
 - Check the cable for cuts etc.
- **If you can't see the last modules there is probably an issue with the load or cable cut**
 - The cable could have a small cross section (less than 1,5mm²)
 - To many bus powered modules
 - Cable cut
 - Dupline Bus cable to long
 - Please go to the section “Calculation”
- **Do we have noise in our installation?**
 - It is possible by using an Oscilloscope to check the Dupline bus if there is noise on the Dupline signal. The signal should look like Fig. 12A



- If the Dupline Bus cable is longer than 1,2Km, then install a DT01 at the end of the cable. If a repeater is used, the DT01 must be installed directly at the repeaters primary side
- If the Dupline Bus cable is installed close to consumers with more than 1 kW then use shielded cable or move the cable away from the consumers (distance more than 50cm)

- Selected cable could be a wrong choice. We recommend always to use 2*1,5mm² twisted and not shielded cable with a capacitance <80nF
- Never connect Dupline D- are to GND
- Do not connect multi-wire cables in parallel to increase the cross-section