ACT-DSL-Diversity-RC-System, Users Manual

Introduction / Functions of the DSL system

The DSL system consists of DSL radio control receivers, which can be operated alone or in combination with other DSL receivers. These receivers offer many new functions for controlling servos and for analysing internal processes. When used in conjunction with another DSL receiver to form a Diversity receiving system, these receivers provide an unprecedented level of transmission security.

DDS Synthesizer Technology (Direct Digital Synthesizer)
This new Synthesizer technology makes it possible to set the reception frequency without any regulatory process, as required with a PLL Synthesizer. This means that the receiver's RF technology is independent of voltage regulation and frequency regulation processes. Detecting and switching individual frequency channels takes only a fraction of a second, and this opens up completely new potential applications. There are no oscillations caused by a regulatory system, and the set frequency is rock-stable. The servos remain absolutely calm.

PCS System
The DSL receiverers are utilising **PCS technology** (Pulse Controlling System), a new process designed to prevent unwanted servo deflections in PPM operation. The system smoothes out any deflections, but allows slight servo unrest or delayed servo response to occur, thereby enabling the pilot to realise that there may be a problem. There is no hysteresis at the switch-off point if interference is detected; the point where it was switched off is the point it is switched on again (major difference compared to PCM systems). Programmable servo positions can be set if interference should occur (fail-safe).

SPS Function
The integral **SPS system** (Servo Programming System) allows all servos to be assigned to any output with complete freedom, even when a Diversity system is in use. All servo travels and directions are variable, and three additional mixer functions are available for each servo output. The mixers are variable, and can be triggered (switch function) by all servo channels, battery voltage, field strength values or fixed values. These integral features make complex transmitters superfluous, and provide adjustment facilities which are not possible even with the most expensive transmitter. These features relieve the transmitter software of nearly all of its work. The settings can also be stored in a Palm hand-held computer and transferred back into the receiver (model memory function).

Fail-Safe / Hold
If interference should occur, a servo position can be set for each servo. The positions can be programmed using the Palm or PC, or using the programming plug supplied.

Frequency band scanner
The DDS Synthesizer technology (DDS receivers only) makes it possible to scan the frequency band virtually in real-time; no delay occurs when changes are displayed

Data memory
The receiver features an **internal data memory** which permits the user to record and display in graphic form any variations in field strength and battery voltage. This means that you can analyse the changes in battery voltage during the last 20 minutes of a flight, and optimise the installation of the receiver aerial to eliminate problems shown up by the recorded data. The internal data memory can also be used to record other values, e.g. data from external sensors. The data can be stored in a Palm hand-held computer for subsequent display.

Diversity reception / DSL (Diversity Synchro Link)
Why Diversity technology? Diversity technology maintains the radio link even when frequency-specific interference, spatial interference or interruption occurs, because there are two spatially separated aerials used for reception (aerial diversity). Additional security from interference on one frequency can be obtained through frequency diversity; this means that two transmitters are used, radiating a signal on different frequencies. In the Full Diversity receivers designed for this, the two aerial signals are amplified, filtered and demodulated separately. The two demodulated signals are assessed (multiplied) by their individual signal field strength, and the result is added together. This process generates a fluid transition from one channel to the other, and at the same time considerably increases the signal : noise ratio of the wanted signal. In an extreme case, where both aerial signals suffer from serious noise, a usable signal can still be gained. **A Diversity receiving system therefore always provides optimum reception under the most difficult conditions**. For all these reasons Diversity not only provides a significant increase in range, but is also much more secure at close range (quote from a final degree dissertation in a research institute).

The DSL system can provide Diversity reception if two DSL receivers are coupled together via the DSL data interface. In this arrangement they automatically exchange information about the current reception situation and servo positions. If one receiver encounters momentary interference, or if one aerial is in an unfavourable position, and its signal momentarily fails, the second receiver's data is used to send correct signals to all the servos. In such a system both receivers have equal rights and receive on the same frequency, but - ideally - are connected to **differently positioned aerials** and separate power supplies.

Improvement in reception quality ?

Model aircraft are steadily growing larger, more expensive and more complex, and they are being fitted with far more servos and other auxiliary electronics, all of which require a large number of cables.

All these complications affect normal reception, since every extra cable modifies the "Radio Frequency receiving system", and adversely affects its efficiency. The results of these "interference sources" are not predictable, but one common problem is directional effects which result in blanking of the signal even at short range, often with fatal results.

Until now only one transmission frequency has been used to transfer the signal from transmitter to model, and the (permitted) transmitter power to carry this signal is extremely low. This means that the signal does not always arrive safely at the model, and this problem is exacerbated by the directional effects mentioned above. **These problems are eliminated by the DDS-10 receiver system through Diversity reception.**

Trainer operations

The combination of DDS Synthesizer technology and Diversity reception creates **completely new possibilities for Trainer mode operations**, without requiring any special modules or add-ons in the two transmitters.

The DDS-10 can receive and process two crystal channels simultaneously. These two channels can be programmed as the Teacher channel and the Pupil channel. It is also possible to program the receiver to set the transfer function / channel switch on the Teacher transmitter, and the switch position at which this occurs. The teacher is able to transfer control in the usual way, but no additional Trainer module is required in **either** of the two transmitters.

The whole system can also be carried out using two receivers in the model, connected via DSL (Real Mode). In this case the frequency is not switched. This arrangement provides for Trainer mode operations, but is also suitable, for example, for a complex model which is to be controlled by two pilots. In this case it is possible to select which pilot controls which functions. If one transmitter should fail, control of all functions is transferred automatically to the second transmitter (auto switch-over).

Programming

All functions apart from SPS, Scanner and Data Memory can be called up **without an additional programming unit (Palm)**.

Programming the SPS and data memory functions requires a standard commercial Palm hand-held computer, which must have the Palm OS 3.5 operating system or higher. A cordless connection is used via the Infra-Red interface (Irda). Alternatively the receiver can be programmed using a PC with a direct connection via the serial interface.

These new technologies are a real innovation in radio control applications, and generate many new possibilities for optimising reception, and making the transmission path safer. A Trainer system utilising the T3S system allows signal transmission with two spot frequencies. Formerly it was necessary to carry out all the complex programming at the transmitter, but the use of high-performance RISC processors allows the user to enter and program all the settings in the receiver. This makes it possible to set up functions which are not possible in any way at the transmitter.

DSL receivers

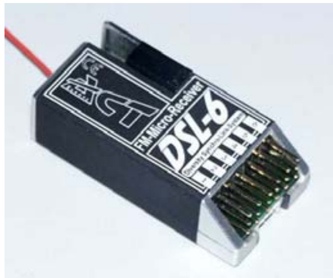
There are five different DSL receivers varying in size and reception performance.

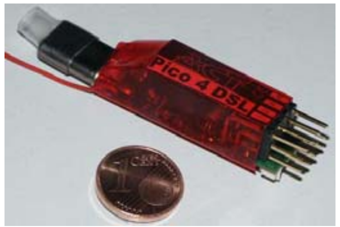
DDS-10 PCM

Specification of the DDS receivers:
MMX-DS receiver section, 35 MHz
DDS dual-conversion synthesizer
IMK aerial input shifting
PPM, PCM-1024, S-PCM (DDS-10PCM only)
Frequency scan
Dual-frequency mode
The latest dual-conversion technology with crystal filters

DDS-10

10 servo channels / outputs
All DSL system functions
AUX switch output for LED indicators
DSQ 15A high-current socket
Weight approx. 42 g
Ultra-robust case with shock-proof system
Optional external receiver power supply with separate battery (DDS-10PCM only)
Dimensions approx. 64 x 54 x 23 mm





DSL 8

8 channels
Dual Conversion
Range > 1500 m
Crystal filter
Weight 19 grammes
Dimensions 54 x 25 x 15 mm

DSL-6

6 channels
Range > 1200 m
Weight 12 grammes
Dimensions 46.5 x 21.5 x 12 mm

DSL-4ST

4 channels
Range > 1200 m
Weight 5 grammes
Dimensions 34.5 x 11 x 11 mm

Functions common to the DSL-8, DSL-6 AND DSL-4:

PCS servo monitor
DSL socket for Diversity and DSL system functions
Selectable Normal mode, Hold mode or Fail-Safe
Operating voltage 4 – 8,5 V
PCS servo monitor
Graphical data analysis
JR connector system, end-mounted sockets for narrow fuselages
DSL-6 + DSL-4: works with ACT, JR, Futaba or MPX crystals
DSL-8 dual-conversion: works with ACT, JR or Futaba dual-conversion crystals
35 / 40 / 41 MHz

Servo connections / crystals / frequencies / voltage

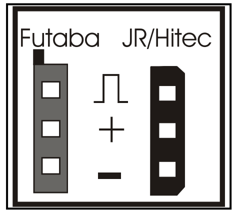
DSL-8, DSL-6, DSL-4 crystal receivers

The receiver outputs are numbered sequentially from left to right. Servos with JR / Futaba plugs can be connected directly; you only need to ensure that none of the connectors is offset (only 2 of 3 pins engaged) when inserted. The plugs must be fitted with the negative (-) wire facing the receiver's circuit board (down); the actual colour of the negative wire is shown in the table.

The receiver nicad can be connected to any of the servo outputs. If all channel outputs are being used, unplug one of the servos, and connect a 'Y' Lead to the receiver. Now one of the lead's connectors can be used for a servo and the other for the nicad or switch harness and nicad.

Kabelfarben der Stecksysteme

System	Minus	System	Minus
JR	Brown	Hitec	black
Futaba	black	MPX	black



Crystals / frequencies
Aerial wire red = 35 MHz, aerial wire green = 40 MHz. The receiver can be operated with different crystal channels within its frequency band (35 MHz channels 61 - 80 and 182 - 191, 40 MHz 50 - 92); the crystal must be changed in the receiver socket to achieve this. The transmitter crystal must be on the same frequency band as the receiver crystal, and the channel number must match that of the receiver crystal.

Operating voltage 4.8 Volts
The receivers continue to operate with undiminished range at a voltage of below 4 Volts, but the servos have less power and run significantly more slowly. This means: take care if you notice the servos running slowly: the battery is flat or defective. The use of 5 NiCd cells or two LiPo cells presents no problem to the receiver, but some servos are not designed to run on five battery cells (> 6 Volts).

DDS receivers

DDS-10 receivers feature ten sockets for connecting conventional servos with 3-pin UNI flat plugs. The signal wire (yellow / orange / white) must be at the top, the negative wire at the bottom. An 11th AUX socket is provided for connecting external LED indicators. The power supply can be connected via any one of the servo sockets, or via the separate DSQ 3-pin high-current socket.

Unless otherwise defined by programming, signals are only passed to those servo outputs to which a transmitter signal is assigned. For example, if the transmitter only generates eight channels, then no signal is present at servo outputs 9 and 10. The same applies whether the transmitter generates 7, 9 or 12 channels. Graupner transmitters, for example, can be set to transmit PPM18 / PPM24 and SPCM. If you wish to control twelve channels (servos), two receivers must be used in Diversity mode; in this case the channels have to be assigned accordingly in the programming process.

DSL Synchro socket	Data interface for Diversity operation / transmitter search
DSQ-Socket	DSQ-type high-current battery socket
Servo sockets 1-10	Sockets for connecting servos
Programming plug	For storing the crystal channel (at the DSL socket)
AUX	For connecting a beeper, LED or other external device

Connecting servos to the DDS receiver
Caution: The signal side (servo signal) of the connector contacts (yellow or orange wire in the servo cable) must always be at the top. The receiver outputs are numbered sequentially from left to right. Servos with JR / Futaba plugs can be connected directly; you only need to ensure that none of the connectors is offset (only 2 of 3 pins engaged) when inserted. The plugs must be fitted with the negative (-) wire facing the receiver circuit board (down); the actual colour of the negative wire is shown in the table on page 3. The signal wire (yellow or white) must be at the top on the receiver.

Setting the receiver channel and modulation (DDS receivers only)
The reception channel (and the PPM / PCM modulation in the case of PCM receivers) is set using the "transmitter search" (scan) facility. The programming shorting plug (supplied) must be connected to the DSL socket before the receiving system is switched on.

In Scan mode (with programming plug fitted) the receiver's transmitter scan program detects the most powerful transmitter. This is normally the owner's transmitter, i.e. the one which is nearest to the receiver. When the Scan process is finished, the detected spot frequency and modulation (PPM, PCM 1024, S-PCM) are stored permanently in the receiver; the data is retained until you initiate a new Scan process. Once the scanning process is concluded, the servos can be controlled from the transmitter in the normal way.

1.) To start the transmitter search, the supplied programming lead with shorting plug must be connected to the 4-pin DSL socket.
2.) Attach the aerial to the transmitter and place it close to the receiver. Switch the transmitter on, operating on your chosen channel.
3.) Switch the receiver on; the scan begins, and is completed within max. 3 seconds (PCM: 1 - 2 minutes). The servos can then be controlled from the transmitter.
4.) Disconnect the bridging plug (shorting plug with lead) (or see Fail-Safe below).

The receiver can pick up all channels in the 35 MHz band which are approved for use in Europe.

Fail-Safe
All DSL receivers (except the DDS-10PCM) can be programmed with user-variable servo positions which are triggered when interference occurs. In the default state the receiver is set to HOLD mode; this means that, if interference strikes, the servos maintain the last positions detected as good; these settings are frozen until the interference is passed.

This is the method of defining the servo Fail-Safe positions: operate the transmitter's controls to move the servos to the positions which they (and therefore the model's control surfaces) are to take up when interference occurs. The programming plug is then used at the receiver to carry out the actual programming.

The programming plug is used to select "Fail-Safe" or "Hold": switch on the transmitter. For Fail-Safe, operate all the transmitter sticks and other controls to move the servos to the positions which they are to take up when interference occurs, then connect the programming plug and switch the receiver on.

Disconnect the programming plug: **within 10 seconds** --> this sets only the spot frequency and modulation; --> existing programmed servo travel settings (via PC / Palm) are not erased.

Disconnect the programming plug: **within 10 - 20 seconds** --> this sets the spot frequency, modulation and Hold for interference; existing programmed servo travel settings are erased.

Disconnect the programming plug: **within 20 - 30 seconds** --> this sets the spot frequency, modulation and Fail-Safe for interference; existing programmed servo travel settings are not erased. If you wish to set Fail-Safe positions only for particular servos, e.g. throttle, you need to carry out the programming using a Palm or PC.

In the case of the DDS-10PCM you can only set Fail-Safe or Hold at the receiver using the PC or Palm. If you do not have a programming device for the receiver, you can still use the normal programming procedure provided by your PCM transmitter to program the Fail-Safe settings.

Power supplies - DDS-10

A JR-system battery connector can be connected to any of the ten servo sockets. However, if you need to provide a high-current supply to the servos, the DSQ high-current socket must be used. This makes full battery power (up to 15 A) available to each servo directly; no supplementary high-current power supply for the servos is required, as the conductor tracks inside the receiver are of very generous dimensions, and are more than capable of supplying even the most powerful servos directly. We recommend that you use the high-current socket if you are using five or more powerful servos - especially if they are digital types. To exploit this feature simply use the two-core DSQ cable supplied.

Caution: do not connect a battery to the AUX socket. The switch output could be ruined if you insert the connector incorrectly.

Power supplies - DDS-10PCM

A JR-system battery connector can be connected to any of the ten servo sockets. If you wish to do this, please note that the 3-pin shorting plug (supplied) must be connected to the DSQ high-current socket (default setting).

However, if you need to provide a high-current supply to the servos, the DSQ high-current socket must be used. This makes full battery power (up to 15 A) available to each servo directly; no supplementary high-current power supply for the servos is required, as the conductor tracks inside the receiver are of very generous dimensions, and are more than capable of supplying even the most powerful servos directly. We recommend that you use the high-current socket if you are using five or more powerful servos - especially if they are digital types. To exploit this feature please use the three-core DSQ cable with integral bridging link (supplied). In this case the thin red wire in the 3-pin DSQ lead is not used, and can be cut off (use of this wire: see below).

If you wish to install separate power supplies for the servos and receiver, the bridging link at the 3-pin DSQ plug can be cut through. If you do this, a separate power supply must be fitted for the receiver. In this case, run the thin red wire to the positive terminal of the additional receiver battery. The negative terminal of the receiver battery can be connected to the bottom pin of any servo plug at the receiver.

Caution: do not connect a battery to the AUX socket. The switch output could be ruined if you insert the connector incorrectly.

Operating voltage
DDS receivers continue to operate with undiminished range at a voltage of 3.5 Volts, but the servos have less power and run significantly more slowly. This means: take care if you notice the servos running slowly: the battery is flat or defective. Maximum voltage is 8.5 Volts; the use of 5 NiCd cells or two LiPo cells presents no problem to the receiver, but some servos are not designed to run on five battery cells (> 6 V).

Connecting DSL receivers to a PC or Palm hand-held computer

Serial cable connection to a PC

If you wish to connect a DSL receiver to a PC by cable, the receiver's serial interface must be used. The first step is to install the DDS-10tool software or POSE (from CD or download) on the PC by clicking on the .exe file in the PC's file manager.

Locate the 4-pin plug on the interface cable and connect it to the DSL receiver; connect the 9-pin socket on the cable to the appropriate serial input of the PC. We recommend that you use a simple serial 9-pin (RS 232) extension lead, available from any computer shop, as this makes it easier to carry out the programming procedure when the receiver is installed in a model.

Click on the tool and start the program: the screen shown on the right appears. Click on "Setup", and the Interface Select window appears. Select the serial port you wish to use (e.g. COM 1).

Now switch on the DSL receiver, and the program is ready for use.

If you alter data or settings during the programming process, please note that it takes a little while for the changes to be stored in the receiver and take effect.

Connecting the Palm using Infra-Red (Irda)

The Irda interface is used for wireless communication with DSL receivers for the purpose of programming, and also forms the DSL Diversity link between two DSL receivers via the two DSL leads after the programming process has been completed. The Infra-Red communication link only works with Palm PDA hand-held computers.

At present any of the following Palms can be used: Palm Z22, Zire 21/71/31, Tungsten T3, Tungsten OS3.1 - 5.X and Garnet 5.4 operating system.

It is also possible to connect only one receiver and use the system for programming.

The Irda interface features two yellow LEDs on the front panel and two transmit / receive diodes in the centre. The Palm's Infra-Red interface must be able to "see" these LEDs, otherwise it will be unable to communicate with the Irda interface. Each yellow LED is connected directly to one of the two leads, and is therefore "responsible" for the receiver connected to it when the system is in use. The plugs are manufactured to the highest industrial standards and are extremely robust for their size. Futaba also uses these connectors in their transmitters, where they are used for the most vital connections. The insulation consists of an extremely heavy-duty woven fabric sleeve which is crimped to the contacts, i.e. pulling on the lead cannot cause the connector to fail. Ribbon cables, although visually perhaps more elegant, do not offer these characteristics and cannot compete in terms of security.

The Irda interface can be installed in the model's cockpit (front face exposed). If you do this, you can carry out the programming from outside the model, without needing to connect or swap cables.

Storing the program on the Palm

If a Palm mini-computer is to communicate with the Irda interface by Infra-Red, it must be running the prc.file (program file) DSL100.prc; this must first be loaded into the Palm.

PC hardware requirements: Windows 95 / 98, XP

Software installation for Palm

You will find the program on the CD supplied with the Irda interface. Place the CD in your PC's CD-ROM drive. Prepare for the HotSync procedure, and search for the files which have to be transferred by HotSync. The program "R100DSL.prc" is found in the POSE folder. Copy this into the folder for your HotSync processes, then carry out HotSync. When the process is complete, the DDS-1035 program is stored on your Palm, and can be launched using the program icon.

The system in use

Connect the cable from the Irda interface to the DSL socket on the receiver(s). Switch on the transmitter, then the receiver(s). After a short delay the LEDs will light up, reflecting the operating mode (see below). They also indicate when communication is taking place with the interface, or between the two receivers.

Switch on the Palm, call up the DDS-10 program and point the computer's Infra-Red interface towards the Irda interface. Press IR on the Palm screen, and one of the two LEDs will flash at a high rate to indicate that communication is taking place with the associated receiver. The system is now functioning, and all the functions of the one receiver can be programmed. During this period the DSL link between the two receivers is interrupted. Press the "IR" field on the Palm screen a second time to switch to the second receiver (if connected).

If you alter any data - e.g. servo travels - please note that transmission to the receiver may take up to five seconds; all the servos will then "jerk" briefly; this indicates that the new settings are now stored in the receiver.

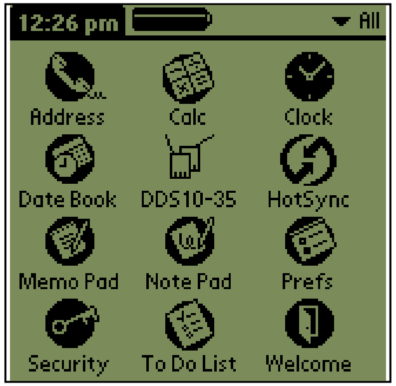
"Flashing yellow LED indicators"

Repeated unequal flashing 1-2, 1-2, 1-2, 1-2	Dual-frequency mode, one transmitter (2) failed
Repeated unequal flashing 2-1, 2-1, 2-1, 2-1	Dual-frequency mode, one transmitter (1) failed
Single high-rate flashing	Receiver programming mode with the associated LED
Continuous light	DSL mode
Simultaneous brief flashing	No transmitter signal received

Note: if you connect two Diversity receivers using the Irda interface, Diversity mode is automatically in force. However, as soon as an active Palm with Infra-Red interface comes into range, the Irda interface switches to "programming mode". For this reason you must always switch off the Palm after completing the programming process, otherwise the system will not switch back to Diversity mode.

Programmable functions DSL System, manual

All the functions of the DSL system can be programmed using the receiver's DSL synchro data port. This is carried out by connecting the DSL Infra-Red Interface, which provides the means of **communicating remotely with a Palm hand-held computer.** The programming procedure can also be carried out **from the PC** using a direct connection via a vacant serial port.

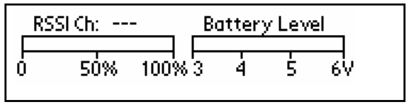


Start the program by pressing this **ICON** with the mouse or stylus. Both receivers and the transmitter must be switched on for programming, and the PC or Palm computer must be connected to the DSL receiver using the appropriate port.
Detailed instructions are supplied with the products.

Start Display

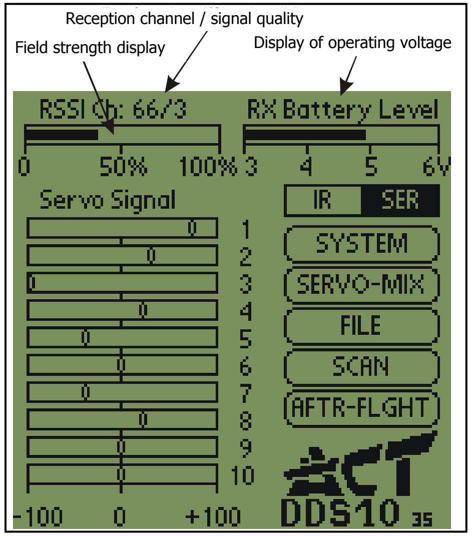
Getting started

If a receiver is not connected, or if the receiver has no power or is defective, the screen just displays three dashes "- - -" instead of the reception channel display. The field strength and battery display remain blank:

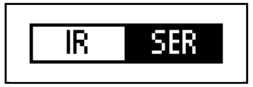


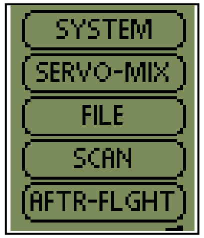
If a DSL receiver is connected and working, the screen displays the reception field strength, the receiver battery voltage and the position (servo signal) of all servo channels.

-100% means a pulse width of 1.0 msec, 0% means 1.5 msec, and +100% means 2.0 msec.



The buttons SER (serial) and IR (Infra-Red) are available for you to select the method of connection. If the receiver(s) is (are) connected via the Infra-Red Interface, you must also select the receiver connected in this way. You can do this by tapping on "IR", which switches between the receiver sockets on the Infra-Red module.

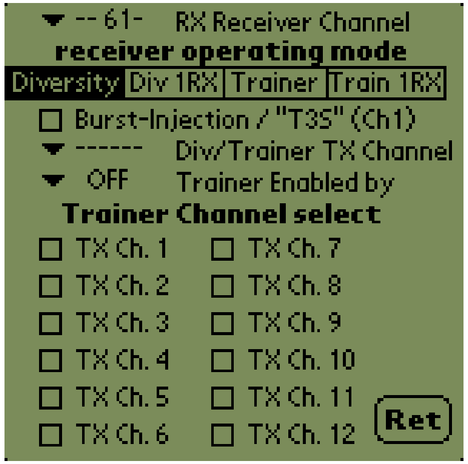




On the right-hand side of the operating area you will see five menu buttons which branch off to associated sub-menus. These are used to display the programming and all the functions of the receiver automatically; they are discussed in detail over the next few pages.

The SYSTEM Menu

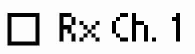
The system menu is opened by tapping on the SYSTEM button. The system data is loaded in from the receiver, and the following screen appears on the PALM hand-held computer:

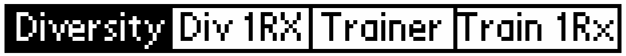


Explanation of functions

At this point you can check and alter various SYSTEM PARAMETERS. Depending on the parameter, this can be activated by CHECK BOX, by RADIO BUTTON or by SELECTOR LIST..

CHECK BOXES are the small empty squares. Tap on the square once to place a tick in the box and thereby activate the parameter. Tap again to erase it and disable the parameter.

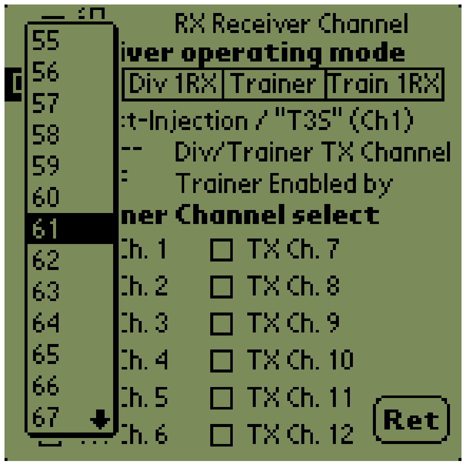




RADIO BUTTONS are selector buttons. It is only possible to select one from a series of these, and this action automatically disables the others. The activated button is displayed in inverse video

SELECTOR LISTs are indicated by a small, downward-pointing triangle. Tapping on the triangle produces a list from which you can select a value. This value then appears in the headline of the SELECTOR LIST.

For example, if you wish to select reception channel 61 (only DDS-10), tap briefly on the "RX Receiver Channel" SELECTOR LIST. A pull-down menu is displayed:



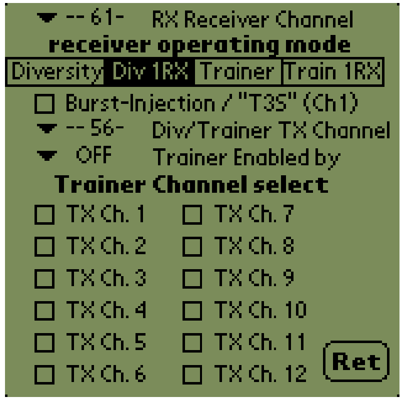
If the desired channel is in the list, you can select it directly by tapping on it with the stylus. If the desired channel is visible in the list, leaf through by tapping the **Continue Arrow** until the desired channel is displayed, then select it in the usual way.

Once this is done, the selected channel is displayed in the headline of the System Display.

Functions of the SYSTEM menu:

Rx Receiver channel: this is where you determine the reception channel on which (only) the DDS-10 receiver is to work. When you select a channel, the information is sent to the receiver directly (serial link) or by Infra-Red; the receiver then switches to this channel and stores it as the new default (standard) channel. If a separate beeper is connected to the AUX output, any change to the EEPROM memory is confirmed by a brief beep.

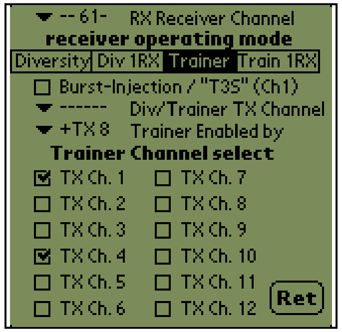
Receiver operating mode: at this point you can select the receiver function.

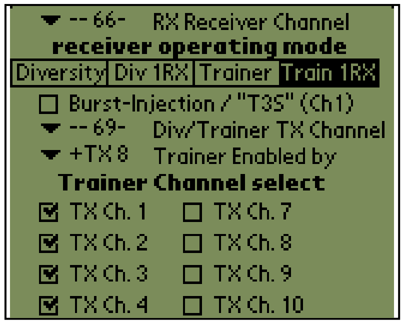


Diversity: standard operating mode, with the option of coupling two receivers for use with one transmitter (Diversity; see above). This mode of operation must be set for normal operation, and for Diversity operation with two DSL receivers.

Diversity 1RX (only DDS-10) (Div1RX): as Diversity-Std., but with ONE receiver and two transmitters operating on two frequencies. The receiver switches over to the alternative frequency if the reception conditions make this necessary, or if a significantly stronger signal is available on the alternative frequency. The alternative frequency is set in the "Div/Trainer RX Channel" Selector List. Switching to the alternative frequency and back is virtually imperceptible

Trainer: two independent transmitters, working on different frequencies, are received by two DSL receivers, coupled by a Synchro-Link cable. With this arrangement the received data can be assigned channel by channel to the Teacher transmitter or the Pupil transmitter. The global Trainer transfer is carried out using a vacant channel at the TEACHER TRANSMITTER; this can be selected in the **"Trainer Enabled by"** Selector List. The receiver functions to be transferred should then be defined using the check boxes "RX Ch. 1" to "RX Ch. 12". The global Trainer transfer channel MUST be left on the Teacher transmitter!





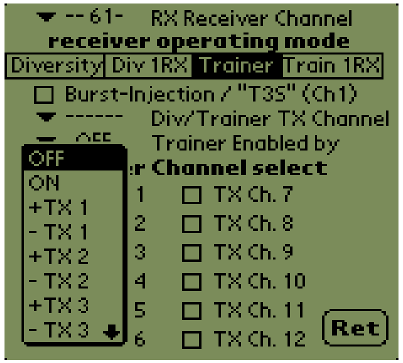
TRAINER 1RX (only DDS-10) (train 1RX): as TRAINER, except that only ONE receiver is required; the reception frequency is constantly switched over. The reception frequency of the Pupil transmitter is defined in the "Div/Trainer Rx Channel" Selector List. All other Trainer functions as for TRAINER (2RX).

The servos will move a small bit slower as normal, but with normal power and always with enough speed to control the trainer model. In this mode, the RSSI levell will not be displayed in the start display.

Div/Trainer TX Channel (Selector List):
This is where you select the alternative frequency in Diversity 1-RX and Trainer 1-RX modes. In the 2-RX modes (Diversity / Trainer) this list is not available, but the receiver retains the value once you have set it.

By this means you program the DSL receivers to the essential second transmission channel for this Diversity or Trainer mode of operation. At the same time you determine which frequency channel is assigned to the master channel, i.e. the Teacher transmitter (the channel selected in normal Channel Select), and which is assigned to the back-up transmitter or Pupil transmitter (the one in Div/TrainerRX).

Trainer Enabled by (Selector List):
At this point you select the global Trainer transfer switch at the Teacher transmitter (physical switch or other control on the Teacher transmitter). You can select any function channel for this, and you can also choose any position of the selected transmitter switch or control as the positive or negative setting. The switching point is a setting which exceeds the neutral point of the control channel either in the positive or negative position. "Positive position" means that the pulse width of the function channel (control or switch) is less than 1.55 msec; "negative position" means that the pulse width of the function channel (control or switch) is greater than 1.45 msec.



Trainer Channel Select:
Here you select which of the function channels are to be transferred to the Pupil transmitter in Trainer mode, i.e. you define which individual control surface functions the Pupil is allowed to operate when control is transferred to his transmitter.

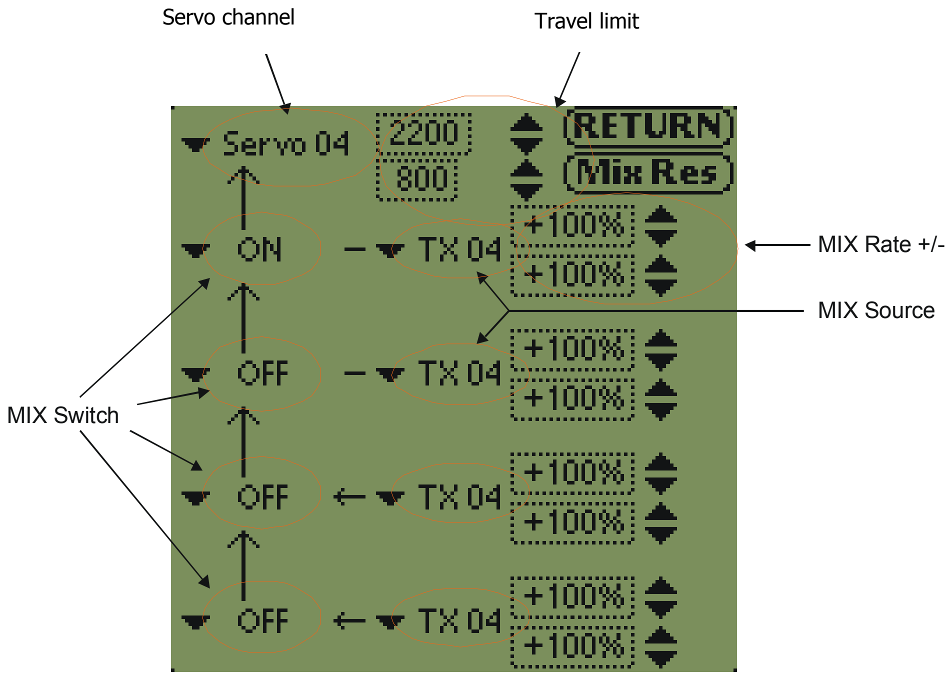
Typical Trainer mode settings:
When channel 8 (transfer switch) on the Teacher transmitter is in the positive position, the Teacher transmitter on channel Ch78 takes over reception channels 1 and 4 from the second receiver connected by Synchro-Link (receiving on the Pupil frequency). If this is not the case, the Teacher transmitter maintains control of all receiver channels.

The Pupil can therefore control channels 1 and 4 on the model when the Teacher operates the transfer switch (channel 8) on the Teacher transmitter (positive position) in Trainer mode.

The same procedure also applies when only one receiver is used in the model.

Servo-Mix Menu

(all DSL receivers)



Every Servo-MIX display always refers to the servo (or corresponding receiver output) indicated for that servo channel (see diagram). Four mixers and two end-points can be programmed for all 10 servos which can be connected to the receiver. Each additional mixer function is added to the first mixer function.

Servo channels:
All servo outputs are programmed in sequence. The corresponding servo output is selected in the "SERVO CHANNEL" Selector List.

Travel limit:
Each servo output features two end-points which can be adjusted in the "TRAVEL LIMIT" field. This function works as a genuine "servo limiter". The displayed values refer to the width of the servo pulse in *sec.

Changes are made by tapping on the UP / DOWN arrows. **The minimum travel between the two end-points is 140 *sec (approx. 15%); it is not possible to reduce the value below this point!** If no change is made for a period of four seconds, the new value is sent to the receiver where it is stored and activated.

MIX switches
The four mixers which are available can be switched on or off selectively. The following options are available as switch functions:

OFF/ON	+TX 1/-TX 1	+TX 2/-TX 2	+TX 3/-TX 3	+TX 4/-TX 4
+TX 5/-TX 5	+TX 6/-TX 6	+TX 7/-TX 7	+TX 8/-TX 8	+TX 9/-TX 9
+TX 10/-TX 10	+TX 11/-TX 11	+TX 12/-TX 12	+Batt/-Batt	SignlOK/SignlLost

In addition to the self-explanatory (constant) conditions 'ON' and 'OFF', all the transmitter's function channels can be used as mixer activation functions in the positive position (> 1.5 msec pulse width) and negative position (< 1.5 msec pulse width). Mixer activation can also be coupled to the battery status (+Batt / -Batt) and receiver status (SignlOK / Signllost) (e.g. to create a fail-safe function).
During diversity use a Fail Safe position only will be given to the sevos if even of diversity use, both receivers don't have a signal from transmitter.

MIX source: mixer signal source
This is where you select the mixer source. The following sources are available:

TX 1	TX 2	TX 3	TX 4	TX 5	TX 6	TX 7	TX 8	TX 9	TX 10	TX 11	TX 12	FIX	RSSI	BATT

'TRX1' ... 'TX12' refers to the corresponding transmitter input channels. Any servo output can be assigned or duplicated in any way by assigning the mixer source.

'FIX' means that the mixer source is a fixed value for the servo position (e.g. for fail-safe or neutral point offset).

'RSSI' is the field strength indicator (Radio Signal Strength Indicator).

'BATT' is the voltage of the receiver battery.

MIX rate +/-: servo travel adjustment
At this point you can enter the positive and negative mixer rate values. This function provides symmetrical adjustment (both ends) of servo travel, enabling you to set the exact servo travel you require. Tap the arrow buttons with the stylus to reduce or increase the numeric values.

Servo Reverse
You can reverse the direction of rotation of the servos (Servo Reverse) by setting negative values for the mixer rate. Tap on the value to reverse the servo direction (reverses the prefix).

If you select 'FIX' as the mixer source, the fixed value should be entered in the Up-Rate field; the DownRate field is set to inactive.

SERVO SIGNAL:
The servo signal is calculated as the sum of all four mixer functions.

Example:
The first mixer must always be active (mixer switch ON) if you wish to control the servo indicated at the servo channel and connected to the corresponding receiver output. If you select the associated transmitter channel as mixer source, the servo will move appropriately.

Servo 01, travel limited to 2200 / 800, mixer switch ON, mixer source TX 1, all values 100%. This means that a servo connected to receiver output 1 moves over its full travel when transmitter control 1 is operated.

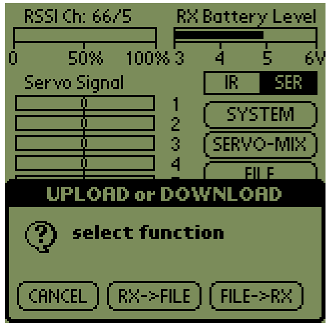
This does require a little careful thinking compared to typical transmitter programming; the logical sequence for setting up the mixer you require is as follows:

1. From which transmitter function channel would I like to control
2. which servo output at the receiver, and
3. turn it on using which switch.

The File Menu

The basic rule is that all the SPS programming settings which you carry out in the Palm hand-held computer are transferred to the receiver and stored **there**. However, if you wish to back-up the settings for later experiments, or alternatively when moving the receiver to another model, it is also possible to store the SPS settings in the Palm (as in a transmitter's model memory).

To do this you must call up the FILE menu at the Start screen.

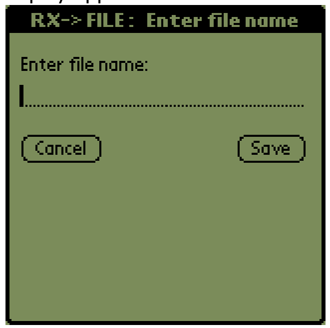


Upload
Here you can select whether
... you wish to store settings / data (file) in the Palm **UPLOAD**.

(RX->file = store settings from receiver in the Palm.)

Download
... or alternatively whether you wish to transfer settings which are stored in the Palm to the receiver (FILE -> RX = load data from the model memory in the Palm into the receiver **->DOWNLOAD**.

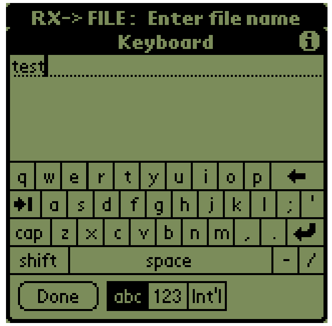
To store a back-up copy of receiver settings in the Palm **(Upload)** you must tap RX -> FILE; the following display appears:

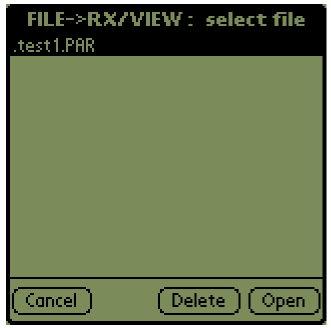


Now you can enter a name for these settings using the Palm keyboard.

The palm keyboard is opened by tapping on the **abcde symbol corners** in the rectangle **below the Palm display**.

Enter the desired name, confirm with **DONE**, and you will see the following display:





The suffix **PAR** (-ameter) is automatically attached to the name you have entered. This means that the FILE contains SPS programming data.

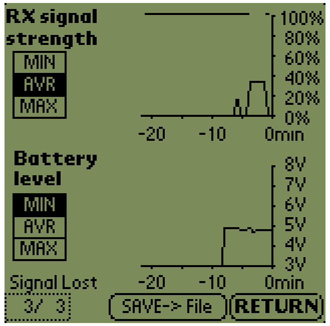
If you subsequently wish to transfer this data into the receiver and activate it, the same FILE (model memory) must be loaded into the receiver by Download (FILE -> RX).

This procedure enables you to transfer settings and data from the Palm to the receiver, and from the receiver to the Palm.

No settings are lost, and you can try out various settings for a particular model until you have found the optimum arrangement.

The number of possible "model memories" varies according to the storage capacity of the Palm you are using. The smallest Palm has 2 MB RAM, which equates to about 300 model memories.

The AFTER-FLIGHT Menu



A very important function of the receiver is to record the reception conditions and battery status during the last 20 minutes of every flight. When the model is back on the ground, you can easily examine the receiving situation and battery voltage which occurred during the flight. The receiver stores a value for reception field strength every 20 seconds, and battery voltage every 60 seconds.

Receiver Signal Strength / Battery Level:
The example printed here clearly shows that the reception field strength fell briefly to '0', and never rose higher than 40% of the maximum possible signal during the flight.

Battery voltage does exhibit slight dips, but it always stayed in the safe range.

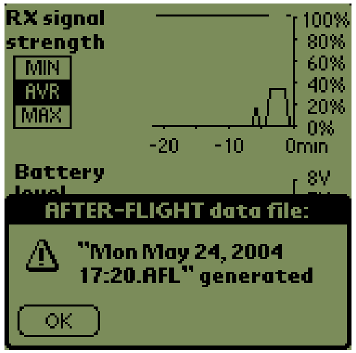
You can select the MIN / MAX / AVE radio buttons to display the field strength and battery voltage curves for maximum value, minimum value and average; the most important value is inevitably the minimum value, and this is the default setting when you call up the menu.

Signal Lost Events:
This shows the number of times the signal was lost during the flight. A signal loss occurs when reception field strength is reduced so severely that the receiver's inherent background noise overwhelmed the working signal, making it impossible to detect the correct signal, or when interference (electric motor, another transmitter) has allowed the receiver to lose track of the synchronous data flow.

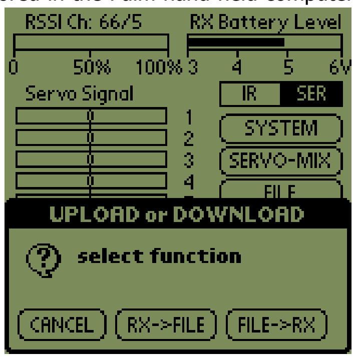
If you study the information in the After Flight menu you can attempt to minimise the value by re-positioning the aerial and/or experimenting with interference suppression measures. A small number of Signal Lost events is relatively normal, but if you find more than 20 such events after a 5-minute flight at normal range, we strongly suggest that you look for the source of interference in the model, or try re-positioning the aerial.

Note:
The screen is refreshed every 10 seconds, at which time the image is erased briefly, then redrawn. The curve is drawn as if with a pen recorder, progressing slowly to the right along the time axis.

Storing the After Flight display in the Palm



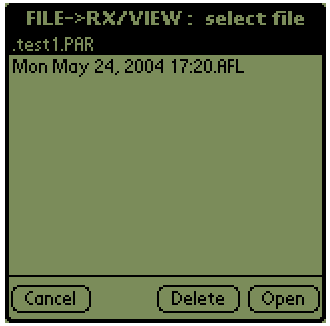
These recordings can also be stored in the Palm hand-held computer and called up again later.



To do this you must tap on the **SAVE -> File** button; the following display now appears:

Press OK briefly to store the displays, together with the date and time of day.

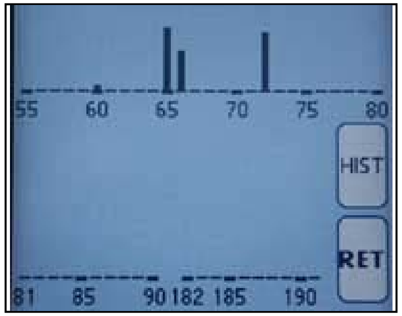
To call up these displays subsequently, tap the FILE button at the Start display. This screen now appears:



The FILE display now appears, showing all the stored data. The stored After Flight data files have an **AFL** suffix.

Tap Open briefly to transfer the graph to the After Flight menu, it will now be displayed on the screen.

The SCAN Menu:



Although the DDS-10 receiver is designed primarily as a radio control receiver, it can also be used to monitor the frequency band. It does not make much sense to install the receiver in a model for this purpose, as the receiver generates NO servo signal during the SCAN process!

The standard method of using the receiver as a frequency scanner is to connect it to the PALM hand-held computer via the serial interface. The receiver must be connected to a power supply! The sequence of switching on the system is not important. If you are using the Infra-Red Interface, no additional cable connection is required.

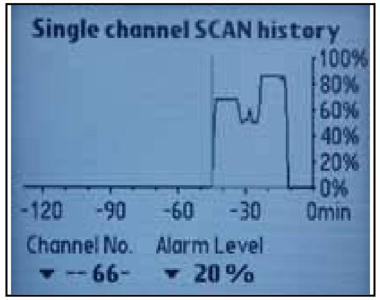
When you select the SCAN menu button the screen display (above) appears on the Palm. It displays all the receivable channels and their momentary field strength. The size (height) of the vertical bar indicates the reception field strength on the individual channel.

The scanner can therefore be used to detect which channels are in use, to trace "rogue" flyers at the slope, and to show up interference.

As well as displaying all the channels currently in use, it is also possible to switch to the HISTORY display (see next page), where you can examine channel usage over the last two hours. Tap on the 'HIST' button to reach the History display.

Notes on usage: radio control transmitters do not radiate a signal exclusively on their nominal frequency; a small proportion of the transmitted energy "spills" onto the neighbouring channels. The field strength display therefore typically looks like a 'bell function', but this is normal, and does not indicate likely interference!

History display
The example shown here clearly shows that channel 63 was in use for about 40 minutes. The vertical dotted line marks the end of the scan range, or the duration of the scanning process to date; in this case 60 minutes.



The display is refreshed approximately every 10 seconds; this causes the graph to be re-drawn briefly. However, the scanning process continues running in the background for ALL channels.

The channel to be displayed is selected by means of the 'Channel No.' Selector List.

You can assign an individual ALARM LEVEL to each channel; when the time has elapsed, the Palm hand-held computer emits a warning sound to alert the user.

Diversity reception / DSL (Diversity Synchro Link)

Why Diversity technology? Diversity technology maintains the radio link even when frequency-specific interference, spatial interference or interruption occurs, because there are two spatially separated aerials used for reception (aerial diversity). Additional security from interference on one frequency can be obtained through frequency diversity; this means that two transmitters are used, radiating a signal on different frequencies. In the Full Diversity receivers designed for this, the two aerial signals are amplified, filtered and demodulated separately. The two demodulated signals are assessed (multiplied) by their individual signal field strength, and the result is added together. This process generates a fluid transition from one channel to the other, and at the same time considerably increases the signal : noise ratio of the wanted signal. In an extreme case, where both aerial signals suffer from serious noise, a usable signal can still be gained. **A Diversity receiving system therefore always provides optimum reception under the most difficult conditions**. For all these reasons Diversity not only provides a significant increase in range, but is also much more secure at close range (quote from a final degree dissertation in a research institute).

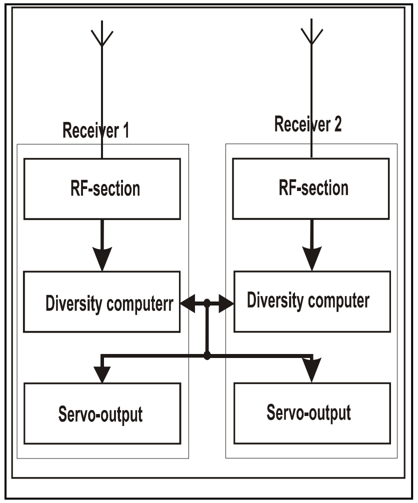
The principle of Diversity operation

The next section explains how Diversity reception works, to help you understand more easily what is happening in Diversity mode, and where the advantages of this mode of operation lie.

As with any receiver, the signals from the transmitter reach the RF section of the receiver or receivers via the aerial(s). In the receivers - as with any other receiver - the RF signals are analysed completely and demodulated. The result is two LF signals of optimum quality.

These signals are passed to the Diversity processors fitted to both receivers. The processors communicate with each other and decide which of the two signals is better; the better signal is then passed to the servo output of **both receivers.**

This means that the signal from the "better receiver" is always shared and passed on to each individual servo output of both receivers.



The DSL system can provide Diversity reception if two DSL receivers are coupled together via the DSL data interface. In this arrangement they automatically exchange information about the current reception situation and servo positions. If one receiver encounters momentary interference, or if one aerial is in an unfavourable position, and its signal momentarily fails, the second receiver's data is used to send correct signals to all the servos. In such a system both receivers have equal rights and receive on the same frequency, but - ideally - are connected to **differently positioned aerials** and separate power supplies.

Range checking with Diversity systems

Standard range checks may show up no particular differences. The advantages only become apparent if you take the trouble to produce virtually a "map" of effective range, walking round the periphery of maximum ground-range all round the model. At those positions and directions in which a single receiver system exhibits obvious problems, the Diversity system with two receivers will always be significantly better.

Using 2 DSL-receivers as a Diversity Receiving Unit

To couple two DSL receivers to form a Diversity receiving unit, the two units have to be connected using the DSL cable. The two receivers then communicate with each other automatically, and the signal from the receiver with the better reception is fed to the servo outputs of both receivers, i.e. the system only makes use of the better aerial signal.

If Synthesizer DSL receivers are used, **both receivers must be set** to the transmitter's spot frequency. If crystal DSL receivers are used, both receivers must be fitted with crystals matching the frequency of the transmitter.

For example, if you have linked one 6-channel receiver and one 10-channel DSL receiver, servo outputs 1 - 6 are duplicated (present at both receivers), while channels 7, 8, 9 and 10 are available only at the 10-channel receiver. However, these servo outputs can be assigned to any transmitter functions (no restrictions) as part of the programming procedure.

If two DSL receivers are used in Diversity mode, there are two methods of connecting the servos: either distributed to both receivers, or all to the first receiver, in which case the second receiver serves only as a second aerial, i.e. there are no servos connected to it. This can offer advantages if only a DSL-4ST or a DSL-6 is used as the "second aerial". However, if a large number of servos is installed in the model, it is always advisable to connect them to both receivers, and thereby "share out" the current load.

In Diversity mode both receivers must be powered separately, as the Diversity lead does not carry power. We recommend the use of our Duo switch harness with Safety Switch, or the AW 15 / AW 30 battery backer with switch.

In Diversity mode it is possible for one receiver to fail without the pilot noticing this from the response of the servos - naturally, the second receiver automatically takes over its function - and with this in mind we recommend the use of indicator LEDs or the Infra-Red interface to alert you to any problem. If you are using DDS-10 receivers, LEDs can be connected to the AUX output to act as operating mode indicators for the Diversity system. These allow the pilot to monitor the correct operation of each individual receiver.

For all other DSL receiver types you can use the Infra-Red interface to monitor the correct operation of the Diversity system.

If you have no means of programming or reading out data using a Palm or PC, then we always advise that you fit LEDs to allow you to monitor the operating status of the DSL receivers in Diversity mode.

Aerial deployment in Diversity mode

The two receivers can be installed directly adjacent to each other, but in general terms the greater the distance between them, the better the reception. The maximum distance is determined by the length of the DSL lead; these are available in lengths of 25 cm and 50 cm.

The basic rule: the two receiver aerials should be spatially separated.

- The two aerials should always be deployed as far away from each other as possible. The optimum arrangement is for the two aerials to be set up offset at 90° to each other, rather than in the same orientation, e.g. one aerial deployed in the fuselage, towards the tail, or vertically upwards, while the other aerial is installed in the leading edge or trailing edge of the wing.
- We strongly recommend the use of whip aerials. On large-scale models one whip aerial can be mounted at the front end of the fuselage, the other whip at the tail end of the fuselage.
- In large gliders there is often no alternative to deploying both aerials inside the fuselage, running towards the tail. In this case it is still important to separate each aerial from the other as far as possible, i.e. running along opposite sides of the fuselage.

In general terms the more "aerial area" of both receivers that is "visible" from the transmitter, in every possible position of the model, the better the reception, and the better the Diversity effect. The basic rule in aerial positioning is that it should not be possible to place the model in any attitude which results in both aerials presenting themselves to the transmitter end-on, i.e. as a point.

Example: in a 3-metre power model one whip aerial is installed aft of the canopy, pointing vertically upward. The second aerial is then routed downward to the bottom of the fuselage, then in a line towards the tail.

From the front the transmitter is faced with the full length of the whip aerial, but only "sees" the major part of the second aerial end-on, i.e. as a dot. One complete aerial is effective in picking up the aerial energy. From the side the transmitter "sees" the full length of the whip aerial together with the full length of the second aerial. In this attitude both aerials are effective in picking up the aerial energy. From the rear the transmitter still "sees" the full length of the whip aerial, but the major part of the second aerial is again end-on. Even so, one complete aerial is effective in picking up the aerial energy.

Diversity/Dual-frequency systems, possible options

1. One receiver and one transmitter on one spot frequency: normal operation.
2. Diversity: one transmitter is used with two DSL system receivers in the model, with Diversity communication; two receiver aerials are installed in the model.
3. Two spot frequencies are used to transmit the signal to the model, doubling the security of the transmission link. This arrangement requires two transmitters. ONE DDS Synthesizer receiver is fitted in the model, with frequency switching (DDS receiver only).
4. Two spot frequencies are used to transmit the signal to the model, doubling the security of the transmission link. This arrangement requires two transmitters, physically separated from each other by a short distance. The two transmitters are synchronised using the T3S system. The transmitters transmit the same control signals on different spot frequencies (synchronously) from one pilot. The back-up transmitter must feature a Trainer function. ONE DDS Synthesizer receiver is fitted in the model, with frequency switching.
5. Two spot frequencies are used to transmit the signal to the model, doubling the security of the transmission link. This arrangement requires two transmitters, physically separated from each other by a short distance. The two transmitters are synchronised using the T3S system. The transmitters transmit the same control signals on different spot frequencies (synchronously) from one pilot. The back-up transmitter must feature a Trainer function. TWO DDS Synthesizer receivers are fitted in the model, linked together in Diversity mode.

Options 3, 4 and 5 can also be used with the dual-frequency transmitter module..

1.) 1 x DDS-10 receiver, 1 transmitter, 1 spot frequency (normal operation)

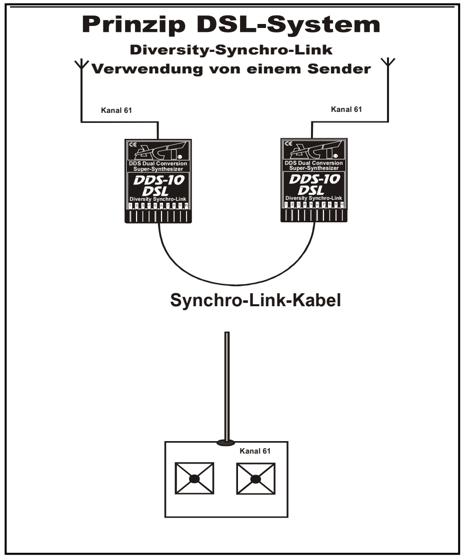
If you opt for this arrangement, you have the best receiver in its class for radio control reception. You require no crystals and have the best range and selectivity available. You can also program servos, store settings externally, scan frequency bands and record events.

2.) 2 x DSL receiver, 1 transmitter, 1 frequency, Diversity reception

The model is fitted with two receivers coupled via their DSL ports, so two receiver aerials are deployed in the model (aerial diversity). The two receiver aerials are mounted separately and apart in the model.

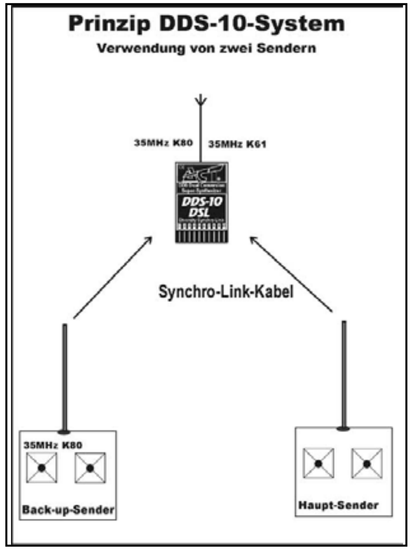
Both receivers operate on the same frequency channel, i.e. the frequency used by the transmitter. They are inter-connected via the Synchro-Link cable.

Since the two aerials are deployed in different directions, one of the two aerials will always have a better position relative to the transmitter than the other one. The two receivers communicate intelligently, with the result that only the better of the two received signals is passed to the servo outputs. This arrangement eliminates directional effects almost entirely. All servo outputs of both receivers are available, since two receivers are used.



3.) Two transmitters, two frequencies, one DDS receiver

Div1Rx, Co-Pilot mode (with receiver programming)
With this arrangement the control signals are transmitted to the model using two spot frequencies. Two transmitters are used, both of them switched on simultaneously and transmitting on different frequencies. All mixer functions and programmed settings must be identical in both transmitters. ONE DDS Synthesizer receiver is installed in the model, with frequency switching. There is one primary frequency and one reserve frequency; the pilot controls the model from the primary transmitter using the primary frequency, while the transmitter operating on the reserve frequency is held by a co-pilot. The DDS-10 is programmed to the two spot frequencies set on the two transmitters.

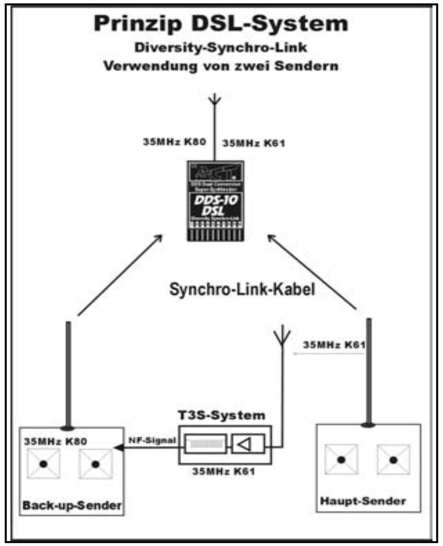


The receiver switches automatically from the primary frequency to the reserve frequency if the primary frequency at the receiver encounters interference. This may be a complete interruption of signal, or just a weak or poor signal on the primary frequency. In either case the receiver switches to the reserve frequency, when then becomes the primary frequency and remains in operation. The receiver will only switch back to the original primary frequency if interference occurs on the reserve frequency. At all times the receiver picks up a signal on one frequency only.

4.) Two transmitters, synchronised using the T3S system, one DDS-10 receiver (only with DDS-10)

Div1RX, 2 Frequency use. With this arrangement the DDS-10 Synthesizer constantly scans two programmable frequencies whilst it operates as a receiver. DDS technology means that this occurs without the pilot being conscious of the switching between channels. At all times only the best of the two transmitter signals is used. Directional effects are greatly reduced because the radiated energy on each frequency channel emanates from a different direction (transmitter 1 or transmitter 2), and one of the two signals will always be better than the other.

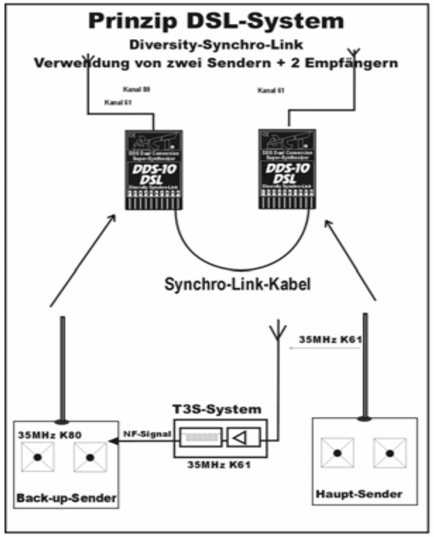
This system uses two frequency channels to transmit data to the model, thereby doubling the security of the radio link; the two transmitters should be spatially separated to some extent. The two transmitters are synchronised with each other by means of the T3S system. The transmitters radiate the same control signals (synchronously), from a single pilot, on different frequency channels; the back-up transmitter must feature a Trainer function (aerial and frequency diversity).



The receiver switches automatically from the primary frequency to the reserve frequency if the primary frequency at the receiver encounters interference. This may be a complete interruption of signal, or just a weak or poor signal on the primary frequency. In either case the receiver switches to the reserve frequency, when then becomes the primary frequency and remains in operation. The receiver will only switch back to the original primary frequency if interference occurs on the reserve frequency. At all times the receiver picks up a signal on one frequency only.

5.) Frequency and aerial diversity, two transmitters on two frequencies with 2 DSL receivers

Transmission security can be further increased if two receivers are used operating on different frequencies, controlled by separate transmitters. The transmitters can be coupled and synchronised using our T3S system in Trainer mode, to avoid having to operate two transmitters simultaneously.



In practice any second transmitter with a Trainer facility can be used simply as the back-up (reserve) transmitter, radiating on a different channel to the primary transmitter. This back-up transmitter is equipped with the T3S system. The T3S system on the primary transmitter is scanned in, and set up close to the pilot, e.g. on a tripod. In fact, only the RF module of the back-up transmitter is used, so the stick mode, mixed functions etc. of this second transmitter do not have to be taken into account, the use of two identical transmitters offers an additional advantage: if the primary transmitter fails, the pilot can continue to control the model using the back-up transmitter. The primary transmitter (which the pilot uses to control the model) does not require a Trainer facility.

The following items are required:

- Two transmitters (PPM modulation)
- One transmitter (back-up transmitter) with Trainer module (socket for Trainer mode as Teacher, with Trainer switch)
- One T3S system
- One T3S adaptor for the back-up transmitter

The model must have two DSL receivers installed in it, programmed to the frequency channels used by the two transmitters.

This system is capable of transmitting the control signals to the model on two frequency channels. The pilot operates one transmitter, the two transmitters are synchronised by means of the T3S system, and the correct control signals are transmitted to the model from the second transmitter on a different channel.

Transmitting on two frequencies (Synchro mode operation with the T3S system)

In principle this arrangement represents the reverse of Trainer mode operations, whereby both transmitters are constantly transmitting a signal (on different spot frequencies), and the Pupil transmitter is the primary transmitter. The two transmitters must be synchronised using the T3S system, i.e. the control signals and the pulse frequency of the two transmitters are matched together via the Trainer system. It is helpful - but not essential - if both transmitters feature the same control facilities, i.e. each transmitter can control the model completely and independently, with all mixers etc. With this arrangement the model can be controlled from the back-up transmitter even if the primary transmitter fails completely.

1. Set different reception frequencies (channels) for each receiver (Channel Select using jumper, or programming, or crystals).
2. Install both DSL receivers in the model and connect them using a DSL lead to form a Diversity unit.
3. Connect the servos to the receivers, keeping to a logical system of distribution, bearing in mind that two servo outputs are available for each of the ten transmitter functions. If you require more functions (up to twelve), the receivers must be programmed with the appropriate assignment and control functions (SPS).
4. Set up any mixers required in the primary control transmitter.
5. Program the second transmitter with the same settings.
6. Install the T3S system for both transmitters, as described in the instructions; the back-up transmitter is the Teacher transmitter, and the T3S system must be connected to this transmitter.
7. Set the Trainer switch on the back-up transmitter to "Continuous Pupil mode". Momentary switches cannot be used for this.
8. Test the system by switching off the transmitters alternately: in each case all the servos must follow the commands of the one transmitter which is still switched on.

In practice, the back-up transmitter should be set up close to the pilot, ideally on a tripod, where it serves only as the second transmitting station. The back-up transmitter should be close enough to the pilot to enable him to reach it in an emergency (the only emergency which can occur with this arrangement is the complete failure of the primary control transmitter); i.e. the pilot can quickly reach for the back-up transmitter. Alternatively the back-up transmitter can be held by an assistant (co-pilot), who can immediately assume control of the model in an emergency.

Transmission path from the primary transmitter to the T3S system

It is conceivable that interference could affect the transmission path from the control transmitter to the back-up transmitter when you are carrying out dual-frequency operations with the T3S system. However, apart from total hardware failure of one transmitter it is very unlikely that the radio link to the T3S system on the reserve transmitter could suffer interference, as this could only occur if the rogue transmitter were physically closer to the back-up (reserve) transmitter than the primary transmitter, i.e. this link can only suffer interference if the signals from the interfering transmitter are more powerful than those from the control transmitter. Even so, correct positioning of the reserve transmitter avoids this problem from the outset. Even if the worst should happen, the interference would not affect the primary frequency in any case.

Total interference could only occur with this arrangement if both the spot frequencies in use were to suffer interference simultaneously, and at the same time one of the interfering transmitters were to be physically closer to the reserve transmitter than the primary transmitter.

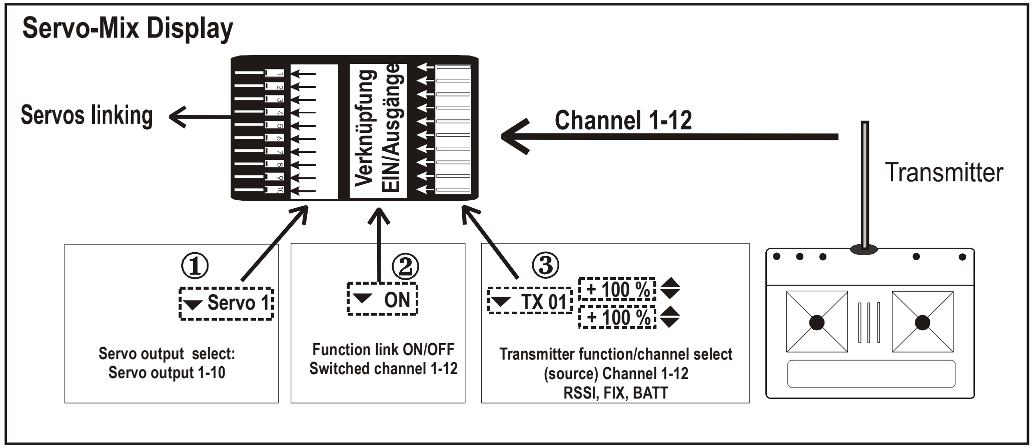
Function test: dual-frequency operation

DIV1RX (DDS only): test with two transmitters on two different spot frequencies. Switch on primary transmitter, system operates. Switch on second transmitter: nothing should change. Switch off primary transmitter; the second transmitter assumes control. Switch on primary transmitter: nothing should change. Switch the second transmitter off again, and the primary transmitter assumes control once more.

DIVERSITY: with two receivers and two spot frequencies; in this case the two transmitters must be synchronised using the T3S system, otherwise servo travel will be limited to half, assuming that both transmitters are of approximately the same power. If not, the more powerful transmitter will "win". Both receivers must be operated in DIVERSITY mode.

Test with two transmitters on two different spot frequencies. Switch on primary transmitter, system operates, both receivers must work. Switch on second transmitter (the one with the T3S system): nothing should change. Switch off primary transmitter; the second transmitter assumes control; alternatively operate both transmitters alternately; both receivers should continue to work properly at all times.

The principle of programming



The DSL-system works in a similar fashion to any computer transmitter: **The servo outputs at the receiver are linked to the transmitter's sticks / controls.**

Signal flow:
All control channels (up to 12) are passed from the transmitter to the receiver. In the receiver the signals pass through three processing stages before they reach the servo output (programming sequence in Servo-Mix menu):

Step 1, selecting the servo outputs
At this stage the user selects the servo output to be programmed (servo 1 - 10).

Step 2, linking the inputs and outputs
At this stage the user selects whether the information from the selected transmitter control (input, TX 1 - 12, Step 3) is to be passed constantly to the servo output (servo output 1 - 10) (ON or OFF), or - if not - the conditions (transmitter control 1 - 12 in positive or negative direction) under which the control information is to be passed to the selected servo output. Switched functions and / or switched mixer functions are also possible.

Step 3, selecting the transmitter stick / control
At this stage the user selects any of the transmitter sticks, sliders or channel switches (TX 1 - 12) to act as the control information source for the servo output selected in Step 1. This function also enables the user to select which transmitter control operates the selected servo output (no restrictions). Further facilities are the FIX value (FIX), the battery voltage (BATT) or the field strength signal (RSSI), which can be selected as information source for the servo output in question. For example, FIX can be used to set the servo centre.

At the same time this step also provides the option of setting the control travel of the "source" (i.e. of the resultant servo travel) for each side of centre, and also the direction of rotation of the servo (+/- 100%).

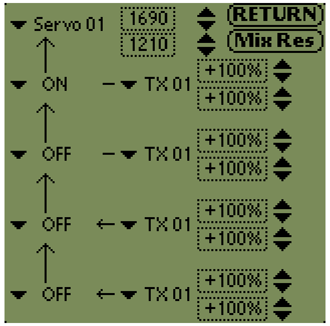
The factory default setting for these programmable functions is that all transmitter controls are assigned to the servo outputs in the same sequence as the transmitter controls, i.e. transmitter channel 1 is present at receiver servo output 1, etc.

Since these three functions are present at four levels for each servo output, up to four transmitter controls can be selected to affect a particular servo; this applies to each servo output. This is the key which opens the door to complex mixer functions.

Programming examples for DSL receivers

The facility to carry out servo adjustments at the receiver is only intended to complement the programming facilities of modern computer transmitters - not to replace them. If correctly applied, the combination of transmitter programming and receiver programming opens up entirely new possibilities. The following examples represent just a small selection of functions known to us which can be programmed in the receiver. This reduces the workload of the transmitter, and may also save space in the transmitter's model memory. Working through these practical examples will help you understand how the system works, and how to adopt a proper systematic approach to programming. Many functions which are possible in DSL receivers cannot be implemented in any way at the transmitter.

Travel Limiter / travel settings

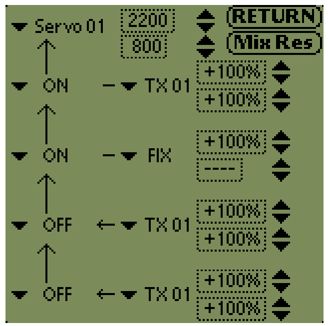


These settings (+ sub-trim, see below) are designed for matching servo travels, e.g. when one control surface is actuated by multiple servos. This function eliminates the problem of servos working against each other, causing them to draw excessive currents.

The travel limiter: each servo output feature two end-points which can be varied in the "TRAVEL LIMITER" field. The method of working corresponds to a genuine "servo limiter". The displayed values refer to the length of the servo signal in µsec.

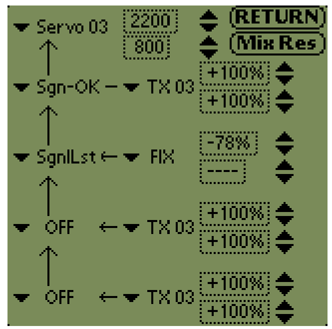
Servo travel adjustment: The mix rate for positive and negative values is entered at this point. The function corresponds to servo travel adjustment acting on both sides of neutral, and enables the user to fine-tune servo travels. The numerical values can be reduced or increased by tapping briefly on the arrow buttons.

Servo reverse
The direction of rotation of the servo can be reversed (servo reverse) by entering a negative value for the mix rate. Simply tap on the value (prefix reverse) to change the direction of servo rotation.

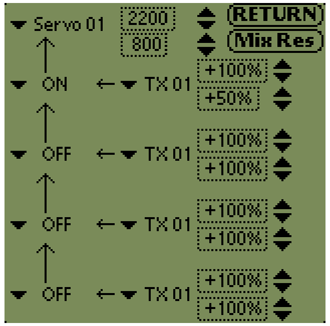


SUB-trim / servo neutral setting
At this point the servo neutral position can be set separately for each servo. This setting should always be programmed at the receiver. If programmed at the transmitter, a change in the neutral point usually produces completely different travels in each direction.

Fail Safe/Hold
The purpose of this function is to define the positions to which the servos move if the receiver should suffer interference. The position can be set separately for each servo. Switch 1 "Signal OK" is set as the mixer switch for the servo in question, and the servo travels and directions are set as required in the usual way. Set "Signal Lost" as the switch for the second mixer, and assign "FIX" as the mixer source: you can now set any servo position over its full travel. Switch the transmitter off (Signal Lost) in order to set the Fail-Safe position. In Diversity mode a programmed Fail-Safe position is only sent to the receiver if - in spite of Diversity operation - both receivers are unable to deliver a valid signal. To set "Hold" for the servo, each "switch" must be programmed to "ON".

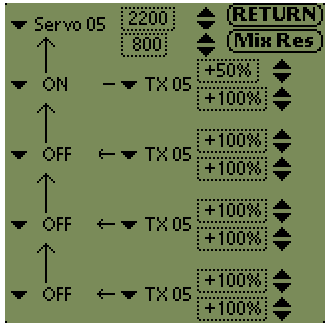


Ail Diff, aileron differential

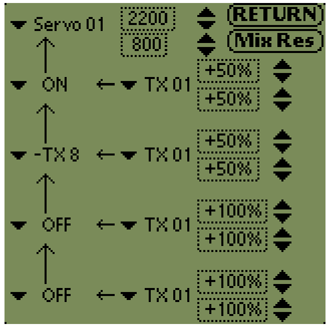


Aileron 1 to servo output 1, aileron 2 to servo output 5.

This function allows you to set up the ailerons with differential travel if your transmitter lacks this facility.



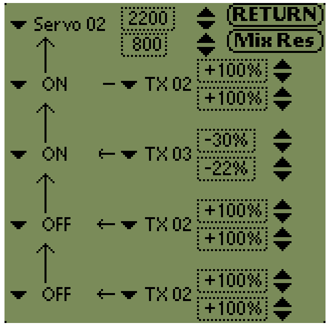
Dual Rate



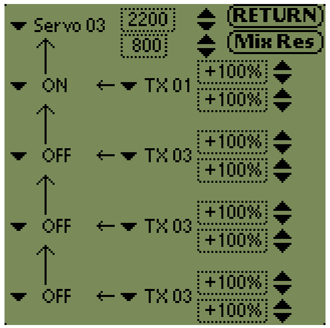
Channel 8 on the transmitter can be used to switch the travel of the servo at output 1.

It is important to ensure that the transmitter neutral position is exactly correct, otherwise the neutral points may differ, causing the model's trim to change when you switch travels.

Channel assignment



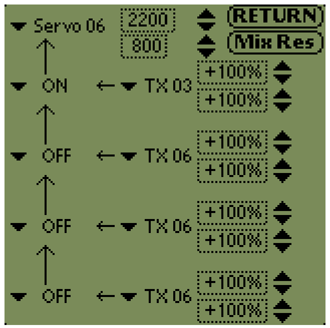
This function is used to distribute and assign the servo outputs to the functions controlled by the transmitter; this is a facility which offers important advantages when programmed at the receiver. For example, in this case transmitter channel 1 operates the servos at receiver outputs 2 and 3 simultaneously, requiring no Y-leads or mixers. Servo travel and direction are variable.



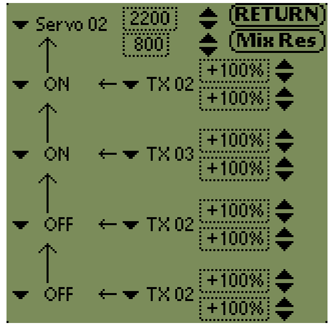
Simple mixers

Throttle --> collective pitch

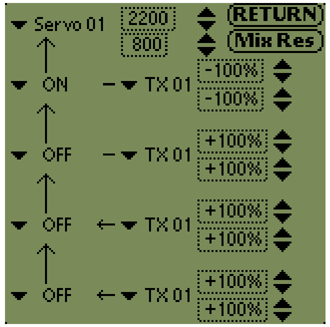
Throttle is transmitter channel 3 and receiver output 3; collective pitch is also transmitter channel 3, but receiver output 6. The result is the same travel at receiver outputs 3 + 6 when transmitter channel 3 (throttle) is operated. Works like a Y-lead.



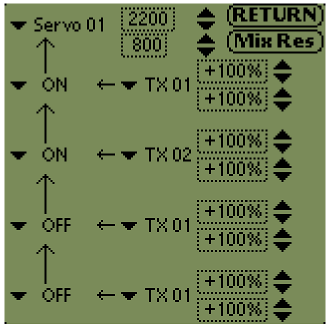
Airbrake --> elevator compensation, elevator is transmitter channel 2 and receiver output 2. Airbrake is transmitter channel 3 and receiver output 3. When you operate the airbrake channel, a compensatory elevator movement is automatically mixed in; the degree of compensation is set in the second line of the mixer.



Servoreverse

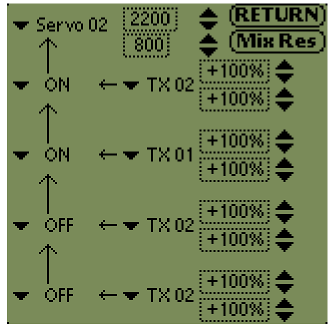


The direction of rotation of the servo can be reversed (servo reverse) by entering a negative value for the mix rate. Simply tap on the value (prefix reverse) to change the direction of servo rotation.

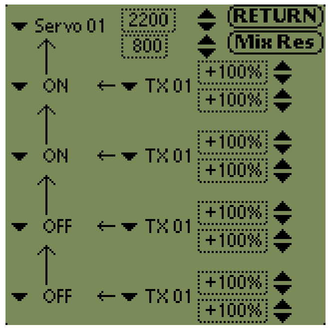


V-Tail

The V-tail functions are controlled by transmitter channels 1 + 2, the receiver outputs also 1 + 2. The mixer values and directions can be set up separately for each control surface and for each side of neutral, i.e. differential travel is also possible.



Servo travel extension



The purpose of this function is to extend the normal servo travel by adding the mixer value in the second line to the mixer value in the first line. This can be very useful with large models, as servo power can be doubled by re-connecting the linkage closer to the centre of the servo output arm; extending the servo travel then compensates for the reduction in deflection at the control surface. It is impossible to program this function at the transmitter. Caution: there are limits to this; ensure that the servos do not strike their mechanical end-stops at either extreme of travel.

Programming strategy: it is advantageous to establish and keep to a "programming strategy" before starting the programming of a complex model. The transmitter is now assigned the task of controlling the model's "functions", while the receiver is programmed with the settings for the individual servos. For instance, aileron is really only one function, but it can be implemented using two (or more) servos. You can now set up the basic servo directions and travels at the receiver, and all you need to do at the transmitter is activate the mixers for the ailerons and differential aileron travel.

If you install a dual-receiver Diversity system in a complex model, in which individual servos are assigned multiple "control functions", the individual mixers should be programmed at the transmitter, and the servos then connected to the receiver outputs assigned by the transmitter.

For example, if you connect the left aileron to receiver output 1a (left receiver) and the right aileron to receiver output 1b (right receiver), the two servos will work as if connected to a Y-lead. In this case it is not possible to reverse one servo at the transmitter, as that would always affect both servos simultaneously.

The same applies if these servos are assigned other mixer tasks, e.g. superimposed camber-changing flaps. In this case it will be necessary either to program everything at the receiver, or to program the mixers and their triggers (mixer switches etc.) at the transmitter, and program the basic servo travels and directions of rotation at the receiver.

In every case it is very helpful to draw up a table in which you define which control surface or which function is controlled by which servo, and to which receiver output each servo is connected (see example below).

Model Nimbus 4, Eight wing flaps

Receiver 1							
Tx. stick /	Tx.	Rx.	Control	Function	Function	Function	Function
control	output	output	surface				
Aileron stick	1	1	Left aileron	Aileron	Flap	Butterfly	
Aileron stick /	2	2	Centre left flap	Aileron	Flap	Butterfly	
throttle slider							
Aileron stick /	3	3	Left inboard flap	Aileron	Flap	Butterfly	
throttle slider							
Aileron stick /	4	4	Left tiplet	Aileron	Flap	Butterfly	Tiplet
throttle slider							
	5	5					
	6	6					
	7	7					
	8	8					
Elevator stick	9	9	Elevator	Elevator			
Rudder stick	10	10	Rudder	Rudder			

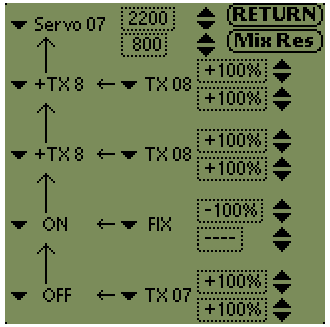
Receiver 2							
Tx. stick /	Tx.	Rx.	Control	Function	Function	Function	Function
control	output	output	surface				
Throttle stick	10	1	Right airbrake	Ext. / retr.	Flap	Butterfly	
Switch R / C / L	11	2	Aero-tow, retract				
Switch R / C / L	12	3	Vario	3-stage			
Throttle stick	10	4	Left airbrake	Ext. / retr.			
Aileron stick	5	5	Right aileron	Aileron	Flap	Butterfly	
Aileron stick /	6	6	Centre right flap	Aileron	Flap	Butterfly	
throttle slider							
Aileron stick /	7	7	Right inboard flap	Aileron	Flap	Butterfly	
throttle slider							
Aileron stick /	8	8	Right tiplet	Aileron	Flap	Butterfly	Tiplet
throttle slider							

Short of transmitter channels / functions?

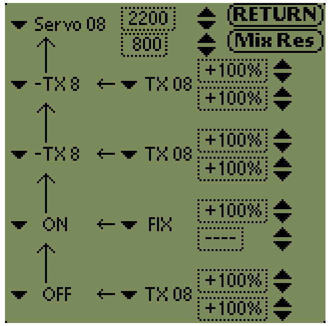
If you have insufficient functions / channels, one option is to assign particular functions to a transmitter channel which is operated by a three-position switch (or slider). You can still program full servo travels at the receiver for each side of the switched channel, i.e. from centre to left and also from centre to right. Example: aero-tow release and retractable undercarriage, or aero-tow and vario, etc.

Example:

Switched 3-position channel (TX 08) switches two servos at outputs 7 and 8, both independently and with full travel from centre to one side of the switch.



Mixer line 1 assigns the same transmitter control (3-position switch, TX 08) to the servos connected to both outputs. In this case both servos work with half of full-travel. Mixer line 2 doubles the travel. Mixer line 3 ensures that the full travel operates from the normal neutral-point of the servo.



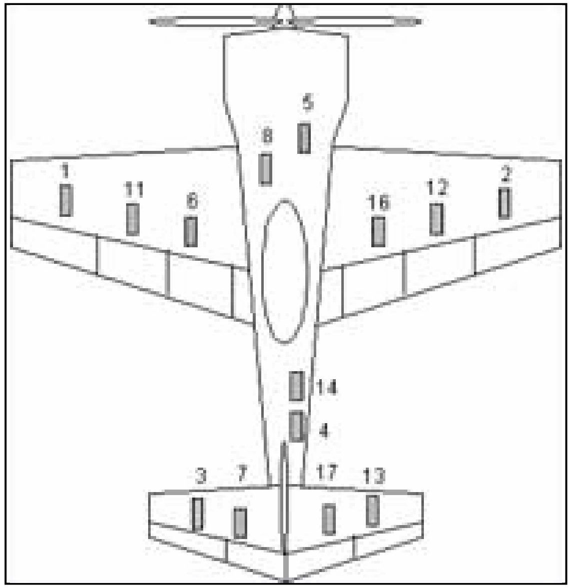
Programming example: aerobatic model

We want to operate a large-scale power aerobatic model with two DDS-10 receivers as a Diversity unit with IRDA. The model is equipped with the following hardware:

* Six ailerons, four elevators, two rudders, one throttle, one smoke system

- Both receivers (RX1 and RX2) operate on channel 73.

* We now need to actuate fourteen servos, arranged as shown in the drawing.



1. Prepare an assignment plan

We strongly advise that you start by preparing an assignment plan. This boils down to determining the sequence of the servo connections as shown in our sketch. RX1 provides servo sockets 1 - 10, RX2 sockets 11 - 20, although in the latter case socket 1 = servo 11, socket 5 = servo 15, and so on.

The servo numbers (receiver sockets) are the same as on a conventional receiver. At the transmitter (TX) we assign the following six control functions: 1 = left aileron, 2 = right aileron, 3 = elevator, 4 = rudder, 5 = throttle, 6 = smoke, 7 = auxiliary (switched channel).

Assignment plan (Sn - servo number n; TXn = transmitter output n)

Receiver 1

- S1 TX1 LEFT AILERON
- S2 TX2 RIGHT AILERON
- S3 TX3 LEFT ELEVATOR
- S4 TX4 RUDDER
- S5 TX5 THROTTLE
- S6 TX1 LEFT AILERON
- S7 TX3 LEFT ELEVATOR
- S8 TX6 SMOKE

Receiver 2

- S11 TX1 LEFT AILERON
- S12 TX2 RIGHT AILERON
- S13 TX3 LEFT ELEVATOR
- S14 TX4 RUDDER
- S15 not used
- S16 TX2 RIGHT AILERON
- S17 TX4 RIGHT ELEVATOR

2. Transmitter settings

Set up the aerobatic model with your preferred arrangement of functions and mixers. At the moment you do not need to take into account the receiver socket sequence, since the DDS 10 allows the signals to be assigned with complete freedom.

3. Programming the receiver using the Palm

A) The Palm is operated by tapping the stylus on the appropriate fields and symbols on the screen (tap with stylus = activate).

- Activate the Infra-Red interface
- Switch the transmitter on
- Switch both receivers on; both LEDs on the IRDA light up
- Switch on the Palm
- Activate house symbol: Windows on Palm
- Activate DDS-10 symbol --> start DDS-10 program
- Activate IR field: only one LED on the IRDA lights up = RX1 is connected to Palm
- * Activate the IR field again: the other LED on the IRDA now glows = RX2 is connected to Palm

B) Select receiver channel 73

- Activate DDS-10
- Activate SYSTEM field
- Activate arrow at top left: channel list appears
- Activate No. 73
- Activate RET. RET corresponds to ENTER, and returns you immediately to the DDS-10 main menu.
- Tap on IR (switches to second receiver), and repeat this procedure with RX2. Both receivers are now set to receive on channel 73

C) Link the servos to the transmitter signals according to your assignment plan

- Activate DDS-10
- Activate SERVO-MIX field: operating window opens; for the moment only the top four lines are of interest.
- Activate the arrow at top left: servo list appears
- Select servo S1
- Activate top TX1 (right); transmitter signal 1 is now passed to servo S1 at receiver socket RX1.

The settings for the remaining thirteen servos can now be entered using the same procedure. As an example we will take servo S7 for receiver 1. This is operated by transmitter signal 3 (elevator): S7 TX3 LEFT ELEVATOR

- Activate SERVO-MIX field
- Activate the arrow at top left and select servo S7
- Activate the arrow at TX7 (right) and select TX2
- Activate RET, confirm and return to main menu

As our second example we will take servo S16 (S6 at receiver 2). This is operated by transmitter signal 2 (right aileron): S16 TX2 RIGHT AILERON.

- Activate IR field: the other LED on the IRDA lights up = RX2 is connected to the Palm
- Activate SERVO-MIX field
- Activate the top left arrow and select servo S6 (= S16)
- Activate the arrow at TX6 (right) and select TX2
- Activate RET, confirm and return to main menu

D) Set Fail-Safe position for throttle

This function mixes into the throttle servo signal an additional signal which the receiver generates if the throttle signal fails. S5 TX5 THROTTLE

- Activate DDS-10
- Activate RX1 using IR
- Activate SERVO-MIX field
- Select servo S5
- Select mixer line 1 as switch, Signal OK
- Activate second mixer line FIX (right)
- Activate OFF in centre of screen. Servo list 1 - 12 appears
- Scroll through list until Sgn lost (Signal Lost) appears
- Activate Sgn lost
- Set servo position: press FIX in the second mixer line until the desired travel in % appears

Test the approximate value in the field
Activate RET, confirm and return to main menu

E) Set servo centre using the FIX function

The servo centre is a central programming function for the calibration of multiple servos connected in parallel to the same control surface.

- Activate SERVO-MIX field
- Select servo (e.g. S16 TX2 RIGHT AILERON)
- Activate second mixer input TX2 (right) and scroll until FIX appears. Activate FIX.
- Set mixer input 2 to ON. Servo centre is activated and now stands at 100% --> servo deflection is 100%
- Set the desired percentage using the double arrow. Caution: it takes 4 - 5 seconds for the receiver to accept the signal
- Activate RET, confirm and return to the main menu

F) Set servo travel and direction of rotation (reverse)

These two parameters are indispensable programming features for accurately setting up multiple servos relative to each other.

- Activate SERVO-MIX field
- Select servo (e.g. S16 TX2 RIGHT AILERON)
- Activate top mixer input TX2 (right)
- Set desired percentage and prefix (for reverse) using the double arrow. Caution: it takes 4 - 5 seconds for the receiver to accept the signal
- Activate RET, confirm and return to the main menu

G) Servo travel limiting

To avoid the danger of mechanical damage, we need to restrict the travel of servo S17 (S17 TX4 RIGHT ELEVATOR) to 80% (up) and 60% (down) at the receiver:

- Activate RX2 using IR
- Activate SERVO-MIX field
- Select servo S7 (= S17)
- 80%: for TX4 (right) set 80% by tapping on the upper pair of arrows. Since the data transfer from the Palm to the receiver is not instantaneous, you will notice the elevator servo moving jerkily; this is normal.
- 75%: for TX4 (right) set 75% by tapping on the lower pair of arrows.
- Activate RET, confirm and return to the main menu

H) Travel increase
We want to increase the servo travel of servo S17 (S17 TX4 RIGHT ELEVATOR) to 160% (up) and 190% (down) at the receiver. This is achieved by mixing in the transmitter signal for elevator a second time; this equates approximately to stacking up the signal.

- Activate RX2 using IR
- Activate SERVO-MIX field
- Select servo S7 (= S17)
- Activate the second TX7 (right): list appears
- Select TX4
- Locate OFF in centre of screen, change to ON: mixer activated
- 190%: for TX4 (right) set 90% (100% + 90%) by tapping on upper pair of arrows
- 160%: for TX4 (right) set 60% (100% + 60%) by tapping on lower pair of arrows
- * Activate RET, confirm and return to the main menu

Trainer operations with the DSL system

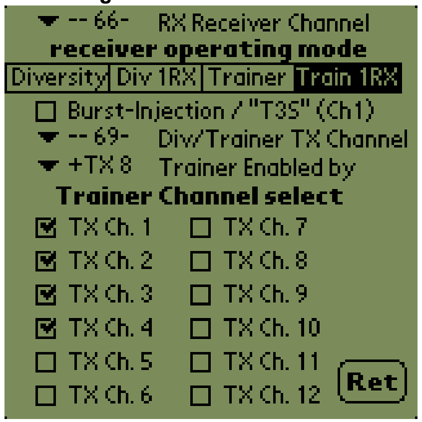
The DSL system offers several alternative methods of carrying out Trainer (teacher / pupil) mode operations. All the options have one feature in common: supplementary Trainer modules are not required in either of the transmitters; all you need is one free control channel at the Teacher transmitter.

Trainer operations with one DDS-10 receiver (DDS-10 only)

Requirements:

- Teacher transmitter with one free control channel, e.g. 3-position switch on channel 8
- The DDS-10 receiver must be installed in the model to be flown.
- The servos must operate in the correct sense (direction) when operated by both transmitters
- PPM operation on both transmitters
- * Same number of transmitted PPM channels (i.e. PPM 18 = 9 channels, etc.)

RX-Settings in the DDS-10 receiver



RX-Receiver channel
--> Spot frequency of the Teacher transmitter

Train 1RX
--> Setting for Trainer mode with one receiver

Div/Trainer TX Channel
--> Spot frequency of the Pupil transmitter

Trainer Enabled by
--> Unused control channel on the Teacher transmitter; used to transfer control between Teacher and Pupil transmitters.

Trainer Channel Select
This function defines the control channels which the pupil is permitted to operate. Please note: the channel used for transferring control (in our example: channel 8) cannot be programmed as a standard control function.

Once you have made these settings, you can switch between Teacher and Pupil transmitters by operating the appropriate switch - in our example the three-position switch (channel 8); the pupil is permitted to operate control channels 1 - 4.

With this arrangement the servos operate slightly less smoothly than normal when the pupil has control. However, servo power and accuracy are sufficient to provide safe control of a standard trainer model aircraft.

Trainer operations with two DSL receivers and DSL link

Requirements:

- Teacher transmitter with one free function channel, e.g. 3-position switch on channel 8.
- Two DSL receivers must be installed in the model to be flown. They are connected to each other using the DSL lead or Irda interface.
- The servos are connected to the receiver which is set to the spot frequency of the Teacher transmitter. The second receiver only receives the Pupil transmitter's frequency.
- The servos must operate in the correct sense (direction) when operated by both transmitters.
- PPM operation on both transmitters
- Same number of transmitted PPM channels (i.e. PPM 18 = 9 channels, etc.)

Settings in the two DSL receivers
Settings in the receiver set to the spot frequency of the Teacher transmitter

Trainer
--> Trainer setting for Trainer mode with two receivers

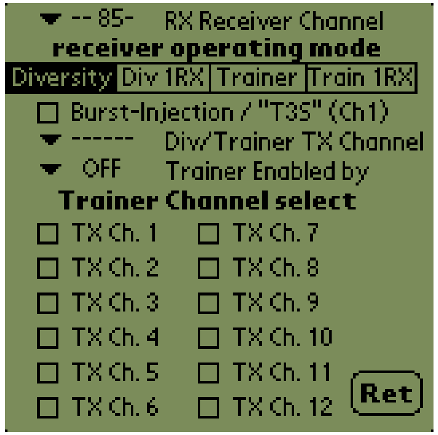
Trainer Enabled by
--> Unused control channel on the Teacher transmitter, used to transfer control between Teacher and Pupil transmitters.

Settings in the receiver set to the spot frequency of the Pupil transmitter

RX Receiver Channel
--> Spot frequency of the Pupil transmitter

Basic Diversity setting
Once you have made these settings, you can switch between Teacher and Pupil transmitters by operating the appropriate switch - in our example the three-position switch (channel 8).

Trainer Channel Select
This function defines the control channels which the pupil is permitted to operate. Please note: the channel used for transferring control (in our example: channel 8) cannot be programmed as a standard control function.



Once you have made these settings, you can switch between Teacher and Pupil transmitters by operating the appropriate switch - in our example the three-position switch (channel 8); the pupil is permitted to operate control channels 1 - 4.

In this mode of operation the servos operate entirely normally, regardless of which transmitter has control.

Tip
If you use the Irda interface for programming, the Palm must be switched OFF when you wish to test the Trainer system. A delay of up to four seconds then occurs, after which communication between the two receivers, as required for Trainer operations, is resumed.

Special feature
Once you have programmed all the model settings in the receiver, e.g. channel assignment, differential, mixers etc., then a vacant model memory can be set up in the Teacher transmitter with simple four-channel control, without any mixers. The Pupil transmitter then requires no mixers at all; the only requirement is that it should have four control channels arranged in the same sequence as those of the Teacher transmitter. Even if the model is fitted with six servos, a perfectly standard four-channel transmitter is all that is required to control the aeroplane, provided that all the settings were programmed in the model itself. This is probably the most efficient solution for club Trainer operations which has been developed to date.

Safety note:
When you are carrying out Trainer mode operations with two transmitters broadcasting via their aerials, the Pupil transmitter must never be allowed closer to the model than the Teacher transmitter. As in normal flight operations, the two pilots should also stand together, to avoid problems caused by an unrelated transmitter which might be more powerful than your own transmitter.

When setting up the model's functions it is therefore always safer to operate the Teacher transmitter with the aerial extended. For practical Trainer operations using the DSL system this requirement can be fulfilled very easily: simply by not switching on the Pupil transmitter until the model is already in the air. Of course, you must not do this unless you have already set up the Pupil transmitter with the model settings and checked that the system works properly. You should also practise the routine of Trainer operations "on the ground" before using the system "in anger" - we hope we didn't really need to mention that.

At the conclusion of the Trainer session you must remember to re-program the Teacher receiver to the basic "Diversity" setting.

Flying in Trainer mode; an exhaustive description of the system in practice

For Trainer mode operations carried out as part of a model flying club's training regime it is standard practice to use a (simple) trainer model aircraft which is flown by all the trainees. With the DSL system it is possible for every learner to fly the same aeroplane using his own transmitter, without extensive programming work or preparation. Even if the model requires complex mixers this is no problem provided that the mixers are programmed at the receiver, rather than at the transmitter.

The basic requirement is two transmitters (Teacher and Pupil) fitted with different crystals. The pupil only has to bring his transmitter and receiver crystal with him (if you are using a DDS Synthesizer receiver as the second receiver, the pupil does not even need his own receiver crystal).

Principle
The model is fitted with two DSL receivers set up as a Diversity unit (or one DDS-10 receiver). Both arrangements are able to process two spot frequencies - the frequencies set on the Teacher and Pupil transmitters. The second receiver is only required to receive the spot frequency of the Pupil transmitter.

In the model, the servos are connected to the receiver set to the Teacher transmitter frequency. This is the receiver with the primary frequency, i.e. the frequency of the Teacher transmitter.

The specific model settings are programmed in this receiver using a PC or Palm. This receiver is also programmed with the Teacher transmitter switch which is used to transfer control between the two receivers (and thus between the two frequencies, i.e. the two transmitters). Any channel switch (or slider) on the Teacher transmitter can be selected for this purpose.
If the model is fitted with a single DDS-10 (single-receiver mode), the switch simply toggles between the two frequencies.

Programming
The primary receiver is also programmed to define the functions the Pupil is permitted to operate when control is transferred, and the functions which are barred to him (individual function transfer). The Teacher transmitter is set up with a vacant model memory which is programmed with the standard settings for that make of equipment. One free control channel, ideally assigned to a switch, must be available. This is used to switch between Teacher and Pupil transmitter.

When the system is switched to the Pupil transmitter, the associated receiver picks up the control signal from the Pupil transmitter, and passes it to the primary receiver via the DSL connection. This means: in Pupil mode the primary receiver carries out the control signals sent from the Pupil transmitter. Since the servos are connected and programmed at that receiver, the servos automatically respond correctly to the control commands.

Procedure
Prepare the Teacher transmitter, and program a vacant model memory with the standard settings: no reversed servos, no mixers. Install both receivers in the model and fit a crystal in the primary receiver. The receiver with the same frequency as the Teacher transmitter is the primary receiver.

Connect the servos to the primary receiver, ideally using the standard sequence recommended by the transmitter manufacturer. Connect the primary receiver to the PC or Palm hand-held computer using the DSL socket (serial connection, or Infra-Red with a Palm).

Program the model-specific settings (servo reverse, servo travels etc.) in the primary receiver. Set the Trainer switch you wish to use (Teacher transmitter) at the primary receiver.

Decide the individual control functions which the pupil is permitted to control, and program them in the primary receiver.

Connect the two receivers using the DSL lead. This completes the settings in the model.

The next step - as with all Trainer mode systems - is to adjust the Pupil transmitter to suit the model. The best method is to set up the Pupil transmitter with basic settings in a vacant model memory. It is helpful if the two transmitters are the same make, and the basic settings are the same, because in this case no re-programming is required, and the sequence of functions and the servo directions will automatically be correct (assuming that the transmitter follows a consistent system for the basic settings in vacant model memories, as is the case with Futaba and Graupner). Throttle left or right, ailerons / elevator on one stick or separate sticks - none of this has to be considered in this case.

The next step is to check everything in both modes of operation: switch the Teacher transmitter on, switch the model on, and check that the model's functions work as expected.

Now fit the Pupil's receiver crystal in the Pupil receiver (or set the DDS-10 to the frequency of the Pupil transmitter).

Switch the Pupil transmitter on
Operate the Trainer switch on the Teacher transmitter to switch to Pupil mode.
Check that the Pupil's transmitter controls the model's control surfaces correctly.

Using the system with different makes of transmitter
Since all makes of transmitter generate different control sequences for the receiver, it is impossible to combine different makes for Trainer mode operations using conventional systems.

However, this is not true with the DSL system; all it requires is one vacant model memory in the Teacher transmitter for each different make of transmitter which pupils are likely to use, i.e. max. two additional model memories, plus the facility to alter the control sequence. This is possible with all the better computer transmitters known to us and sold widely in Europe.

Everything is connected as described above, and the servos remain plugged into the same sockets as programmed for the Teacher transmitter.

The only difference is that the control functions of the different make of Pupil transmitter must be programmed correctly into the primary receiver - but this only has to be done once. These settings should then be stored in the PC or Palm under an unambiguous name, e.g. Trainer Futaba etc.
In the Teacher transmitter you now select another vacant model memory with base settings, and operate the model using the Teacher transmitter.

The control surface check will show a clear mis-match: the control surface deflections will not match the stick movements: moving any stick is bound to produce a deflection in the wrong control surface.

The next step is therefore to set the correct control sequence at the Teacher transmitter. Once this is done, you have to set and check the correct directions of servo rotation at the Teacher transmitter, followed by the correct servo travels.

Once everything is working correctly, just store the new settings in the transmitter's model memory using an unambiguous name.

We suggest that you use the three main makes of RC equipment for these names - Futaba, Graupner and MPX. When you subsequently wish to use a different transmitter you will find that 99% of the work has already been done by this procedure.

Later, if a would-be pupil turns up with a different make if transmitter to the Trainer transmitter, simply transfer the specific program stored on the PC or Palm to the primary receiver, then select the appropriate model memory in the Teacher transmitter - that's all there is to it.

In this way even transmitters with non-standard neutral points (MPX) and different function sequences can be used for Trainer mode operations.

Recommendation
If two simple DSL receivers are used for Trainer mode operations, an FM receiver (DSL-6) should be used as Pupil receiver. You will normally find that a pupil always has a normal crystal (not a dual-conversion crystal) in his pocket. Of course, this does not apply if you are using one or two DDS-10 Synthesizer receivers for Trainer mode operations.

At the conclusion of the Trainer session you must remember to re-program the Teacher receiver to the basic "Diversity" setting.

Table for programming different channel sequences

	Futaba	MPX	Graupner
	Output	Output	Output
Aileron	1	1	2
Elevator	2	2	3
Rudder	4	3	4
Throttle	3	4	1

DSL-System, Questions and Answers

Is it possible to operate twelve control channels with a twelve-channel transmitter?
Yes, that works: two receivers are used and must be wired together as a Diversity unit. The servo outputs then have to be programmed accordingly using a Palm hand-held computer.

What happens if the primary transmitter fails in dual-frequency mode with T3S-Synchro?

In this case the back-up transmitter continues to transmit; control is resumed instantly and seamlessly.

What happens if another model pilot switches on his transmitter on the same channel that is being used in dual-channel mode with the T3S radio link?

In this case the primary transmitter continues to work correctly, and controls the model without interference. However, this situation virtually cannot occur in practice, because the interfering transmitter would need to be closer to the back-up transmitter (with T3S system) than the primary transmitter.

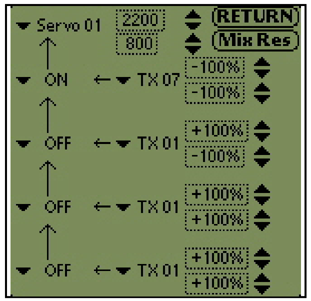
How can the user establish the range limit during a range check?
The PCS system effectively eliminates the intermittent servo movement and jitter which are familiar indicators of the range limit, and at the limit of range the only sign of a problem is that the servos respond with a slight delay or lack of smoothness, even though they still move in the required direction. When there is no signal at all, the servos simply stay still (but remain under power).

When do the servos run to the programmed Fail-Safe positions in Diversity mode?
Not if only one receiver encounters interference, as the other receiver substitutes the invalid signal. The servos only move to their Fail-Safe positions if both receivers suffer total interference.

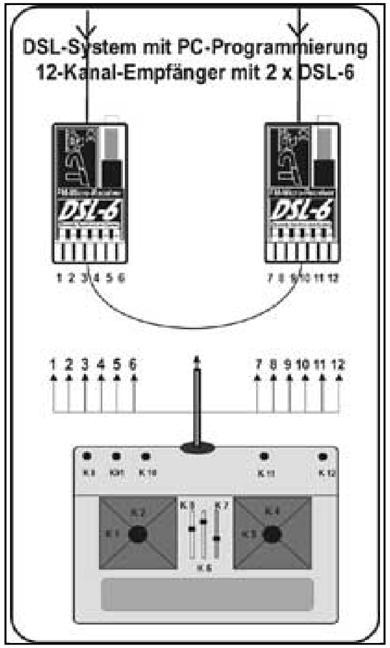
Do I need a new twelve-channel transmitter if I wish to fly models with many servo functions?
No, that's not necessary; for example, a 9-channel transmitter is sufficient to control gliders with eight wing-mounted control surfaces if the DSL system is used.

The reason is simple: the servos and mixers are set up at the receiver; all the transmitter has to do is control the individual functions - not the individual servos. A little re-thinking is called for here: the transmitter is responsible for the control functions, but the receiver is responsible for the servos.

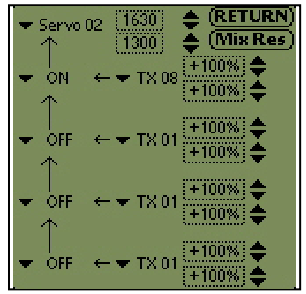
Generating a twelve-channel receiver with two DSL receivers



This presents no problem with DSL system. Since the servo outputs are freely programmable and can be assigned in any way, the servos for (say) transmitter channels 1 - 8 are passed to receiver No. 1, the servos for transmitter channels 9 - 12 to receiver No. 2, typically connected to outputs 1 - 4 (this varies according to the receiver in use). The actual sockets employed are not important, as the servo assignment relative to the servo outputs is freely programmable



Example with two DSL-6 receivers
The transmitter broadcasts twelve control channels (1 - 12). The outputs of the two receivers are assigned in such a way that receiver 1 generates the transmitter's control channels 1 – 6 (this happens automatically), while receiver 2 generates control channels 7 - 12 (according to the programming carried out in the Servo-Mix menu).



These settings are made in the Servo-Mix menu, where transmitter output 7 is assigned to output 1 of the second receiver (etc.).

The servos connected to each receiver can be programmed separately with all the functions of the DSL system.
Both receivers pick up all the control channels arriving from the transmitter, i.e. even transmitter channels 9 - 12 can be assigned to a four-channel receiver.

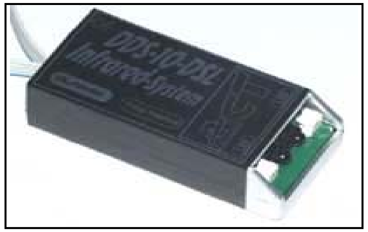
If you need to control twelve transmitter channels, your DSL system must include at least one programmable DSL receiver, and you will also need a PC (laptop or Palm) and a programming interface.

DSL system accessories

Connections / programming

Serial interface
This unit is required for programming the DDS-10 using a PC or Palm and a cable connection (serial connection only). If used with a Palm, you will also need a null-modem cable or null-modem adaptor. This interface is also used with earlier SmartScan receivers. Supplied with DSL adaptor and software for PC and Palm.

Infra-Red interface (Irda)
Required for wireless programming of the DDS-10 using a Palm hand-held computer. Works with the Palm M100 - M130, Palm Zire - Palm Zire 71, Palm Tungsten T3 and some Handspring PDAs.
The Infra-Red DSL interface also works as a DSL lead (communicating connection between the two receivers), and can be installed permanently in the model. For example, it is possible to carry out programming procedures externally if the interface is installed in the model's cockpit. The operating status of each individual receiver is also indicated by the LEDs, i.e. it gives the user a means of detecting interference to one receiver. Supplied with software for PC and Palm.



Suitable Palm hand-held computers
Palm Z22
We are also able to supply you with a suitable Palm computer. We recommend the Palm Zire 22 (especially in conjunction with the Irda interface), as this provides a means of programming and frequency scanning "wirelessly". The DSL software is already loaded on the Palm by us.

Palm hand-held computers are available in many versions; for more information please contact Palm One directly.

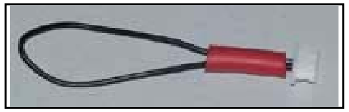
At present any of the following Palms can be used: Palm Z22, Zire 21/71/31, Tungsten T3, Tungsten OS3.1 - 5.X and Garnet 5.4 operating system.

DSL cable, 25 cm
For connecting two DSL receivers for Diversity mode operations

DSL cable, 50 cm
For connecting two DSL receivers for Diversity mode operations

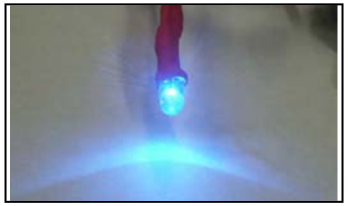
DSL socket / extension lead
For re-positioning the DSL socket in a remote location, where the DSL receiver is inaccessible inside a model, but you wish to use the Irda / serial interface with it.

DDS-10 programming plug
This can be used to select the spot frequency and mode of operation when programming DDS Synthesizer or Fail-Safe systems. It works with all DSL / digital receivers and requires no additional programming equipment.



Piezo sounder
Designed for connection to the AUX output; provides audible confirmation of programming procedures and Diversity modes..

LED status indicator, blue
Ultra-bright blue LED, designed to indicate operating status and Diversity functions, supplied complete with mounting sleeve. An important accessory when you require a display of the function of each DDS-10 in a Diversity system.



LED status indicator, red
Ultra-bright red LED, designed to indicate operating status and Diversity functions, supplied complete with mounting sleeve. An important accessory when you require a display of the function of each DDS-10 in a Diversity system.
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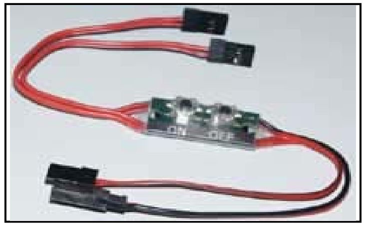
Power supply accessories

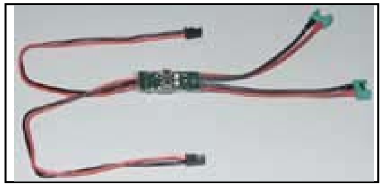
DSQ high-current cable, 2-core
For high-current power supply to the DDS-10 receiver.

DSQ high-current cable, 3-core
For high-current power supply to the DDS-10PCM receiver. Separate power supplies for the servos and receiver can be used.

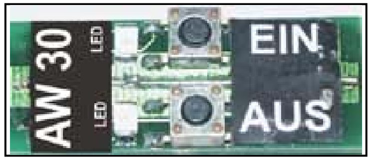
Safety Power Switch 5A Duo
Continuous current 5 A, peak 15 A, with Futaba / JR connector system, conductor cross-section 0.5 mm², with two output connectors: one for each DSL receiver



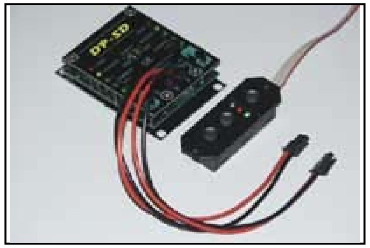
AW 30DSQ battery backer with electronic security switch
The AW30DSQ battery backer can be used in a system employing two DDS-10 receivers in Diversity mode. It offers enhanced security through the use of two batteries to supply the heavy current requirements of the twenty servo outputs. The unit is connected directly to the DSQ high-current socket present on each DDS-10 receiver. Minimum possible component complexity: exclusively passive elements in the power supply, so there is nothing to fail or burn out. Supplied with mountings, bezel and drilling template. Brief 50 A current capacity, peak 80 A.



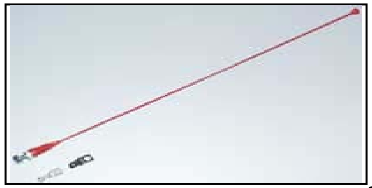
AW 30DSQ battery backer with electronic security switch, (circuit board only)
For making up your own receiver power supplies. 30 A capacity and two batteries offer high-level security for heavy current requirements of up to twenty servo outputs. Minimum possible component complexity, exclusively passive elements in the power supply. Brief 50 A current capacity, peak 80 A.



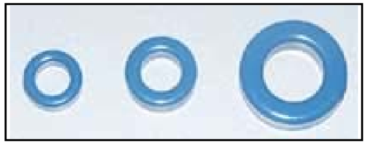
DPSD
Battery backer for LiPo / NiCd receiver batteries
For use with DDS receivers and two LiPo cells or five NiCd / NiMH cells. Stabilised voltage of 5.9 Volts, current 10 A, voltage display, with external electronic switch.



Whip aerials
For optimum aerial deployment with Diversity systems. Available in lengths of approximately 25 cm and 45 cm.



Ferrite rings
For interference suppression with long servo leads
Order No. 95 5005, 8 mm I.D.
(3 - 4 turns of 0.17 mm cable)
Order No. 95 5006, 9.5 mm I.D.
(3 - 4 turns of 0.33 mm cable)
Order No. 95 5007, 15 mm I.D.
(3 - 4 turns of 4 x 0.25 mm cable)



Note: DSL cables, programming cables
It was essential that the DSL socket on the DDS-10 receiver should be as small as humanly possible, and nevertheless satisfy the most stringent requirements. For this reason the plugs are manufactured to the highest industrial standards and are extremely robust for their size. Futaba also uses these connectors in their transmitters, where they are used for the most vital connections. The insulation consists of an extremely heavy-duty woven fabric sleeve which is crimped to the contacts, i.e. pulling on the lead cannot cause the connector to fail. Ribbon cables, although visually perhaps more elegant, do not offer these characteristics and cannot compete in terms of security. The connectors are polarised, and engage with a distinct snap.

The small heat-shrink sleeve serves as a tool to help you generate slightly more pressure when pushing the plug into the socket. The sleeve on the DSL cable can be slid to and fro, and can therefore be used at both ends. It is certainly safe to disconnect the cable by pulling on the cable itself; however, in the interests of maximum useful life please don't pull harder than is strictly necessary.

Supplementary hints and tips

Diversity sets
The DSL receiver system offers a wide range of possible combinations, and some of these combinations are available at particularly favourable prices in the form of Diversity Sets, in each case including DSL cable, interface, or power supply. These offers are listed in full in the ACTshop on the company website.

In a Diversity system each DSL receiver is capable of restoring the entire received signal to the other receiver, regardless of the number of servo outputs it features. In an emergency, this means that even a four-channel Pico 4 DSL can provide a complete substitute signal to the DDS-10, with the result that all ten servo outputs continue to work normally.

PCS servo monitor
The PCS circuit constantly monitors the servo outputs, checking them for plausibility. This means that there are no unwanted servo deflections towards the effective range limit. If actual radio interference should strike, the user can choose whether the servos remain in the last positions found to be plausible (Hold mode), or run to a user-selectable position (Fail-Safe), e.g. motor stopped etc. Of course, these positions are only maintained as long as the interference persists. PCS offers a distinct advantage here, as it switches back to normal operation much faster than a PCM system. PCS allows the servos to become slightly restless before the receiver decides that interference is occurring, with the result that the model feels distinctly "less responsive". This gives the pilot fore-warning of interference, rather than suddenly causing complete loss of control.

The ACT-PCS system does not carry out a synchronisation process with the transmitter, and this makes signal transfer faster than with PCM equipment. The signals are only analysed as they arrive at the receiver. Modern PPM technology makes this possible with great accuracy and no loss of speed. The result is that the receiver switches instantly back to normal mode when the interference is finished, instead of requiring the reception of multiple "clean" signals before the system starts working again. You can check this by carrying out a range check: the system will switch itself back on at almost exactly the same point where it switched itself off.

The servos become slightly restless before the receiver decides that interference is occurring, with the result that the model feels distinctly "less responsive". This gives the pilot fore-warning of interference, rather than suddenly causing complete loss of control. We call this the "sliding" Fail-Safe function, as it always gives the pilot time to change the model's heading and regain better reception before disaster strikes.

In practice the PCS system is an extremely important factor in obtaining reliable radio reception, as it makes a very great contribution to the high overall quality of all PCS-equipped receivers (Digital 4 - Digital 8, DSL-8, DDS-10, DDS-10PCM).

Range checking

Whip aerial with one receiver
The optimum method of deploying the aerial is to install a whip aerial with a short horizontal run followed by a vertical upward path. At the same time the servo and battery leads should be located as far away as possible from that part of the aerial wire which is deployed inside the fuselage. The basic rule in aerial positioning is that it should not be possible to place the model in any attitude which results in the aerial only being "visible" to the transmitter end-on, i.e. as a point (no projected area). This position generates the weakest field strength at the receiver input, and can lead to problems if other aspects of the installation are also unsatisfactory. It is therefore important to ensure that at least part of the aerial is always deployed vertically, so that the aerial represents a combination of horizontal and vertical elements. Basically the first part of the aerial should be routed horizontally away from the receiver, while the remainder should stand upright. The larger the vertical part, the less marked the directional effects, and the lower the influence of other aspects of the radio installation.

Comparative range checks
Radio installations vary widely from model to model. Even if you are confident that everything usually works fine, you can avoid potential problems by testing every new receiver, and checking even existing, proven receivers when they are fitted in a new model.

Test program
If your transmitter includes a servo test facility, then please use it, as it allows you to hold the transmitter in a defined way, or even not to hold it at all, when testing an installation. We place the transmitter in a transmitter tray and allow it to point towards the model, hanging in front of the operator, with the aerial angled up towards the sky above the model. The actual attitude is not crucial; the only important point is that the situation is always the same, otherwise you will have no basis for comparing the results of your tests. Do not stand with your own body between receiver and transmitter aerial when checking effective radio range.

For all range checks please note the following: there should be no metallic objects, such as tabletops or similar, close to the location of the receiving system.

Defining the range limits, preparing a range "map"
The first step is to use the transmitter to establish the range limit in one particular direction. The limit is reached when the control surfaces no longer follow the control commands correctly. At this point, start walking in a circle around the model: you will soon discover there are areas in which the effective range is significantly lower. When you find a weak spot, walk towards the model until reception is present again. In this way you can draw up a map of radio range, which will show you the directions in which reception is relatively poor, i.e. angles at which the transmitter's signal is picked up weakly by the receiving system. It is not normally possible to eliminate these "blind" spots, but it can be very helpful to know the directions in which they lie.

In basic terms this weakness can only be prevented by employing Diversity reception, as this increases the effective range by a factor of 4 - 8, and eliminates the weak points or dangerous directions, as two aerials are always used to receive the signal.

Comaparative table

Comparative table	**Software / functions**	**DDS-10**	**DDS-10 PCM**	**DSL-8**	**DSL-6**	**DSL-4ST**
PPM / PCM 1024 / S-PCM			x			
All PPM transmitters from PPM 7 to PPM 12-channel	PPM 7 - 12	x	x	x	x	x
DSQ crystal filter	DSQ dual-conversion receiving syst.	x	x	x		
35 MHz	35 MHz frequency band	x	x	x	x	x
40 MHz	40 MHz frequency band			x	x	x
MMX RF receiver stage	Latest µP dual-conversion RF technology	x	x			
DDS aerial input tuning	IMK shifting, max. selectivity	x	x			
DDS channel scan oscillator	Direct digital frequency synthesis	x	x			
Palm / PC connection	DSL socket, Infra-Red or cable	x	x	x	x	x
Connection between two DSL receivers	DSL Diversity, diversity reception	x	x	x	x	x
Programmable frequency selection	Channel select, frequency selection	x	x			
All servo mixers, all switches, all sources	SERVO-MIX, SPS servo programming	x	x	x	x	x
Freely programmable servo assignment	FUNC, servo function change	x	x	x	x	x
Servo reverse	Reverse, servo direction reverse	x	x	x	x	x
Travel adjustment	Servo travel adjustment, each side of centre separately	x	x	x	x	x
Limiter	Limit, maximum travel setting for each side separately	x	x	x	x	x
Servo delay	Servo speed setting, each side		x			
Dual-frequency operation with one receiver	Div1RX	x	x			
Trainer mode operation with one receiver	Trainer 1RX	x				
Dual-frequency operation with two receivers	Diversity	x	x	x	x	x
Trainer mode operation with two receivers	TRAINER	x	x	x	x	x
Frequency monitoring, frequency band	Frequency scan, entire frequency band	x	x			
All settings stored in Palm or PC	File, storing of all mixers / model memories	x	x	x	x	
All graphical data stored in Palm or PC	After Flight, graphics storing	x	x	x	x	
RSSI field strength indicator	RSSI	x	x	x	x	x
Battery voltage display / monitor	BATT	x	x			x
Switched output, beeper / LED	AUX switched stage, mode indicator	x	x			
Transmitter channel scan with programming plug	Channel scan	x	x			
Freely programmable Battery Fail-Safe	BATT source	x	x			x
Freely programmable Fail-Safe	F/S, Fail-Safe	x	x	x	x	x
RSSI programmable to servo	RSSI as source	x	x	x	x	x
Fail-Safe positions with programming plug	Fail-Safe, selectable using plug	x	x	x	x	x
HOLD pre-set	Hold mode, selectable using plug	x	x	x	x	x
DSQ high-current socket for separate receiver supply			x			
DSQ high-current socket	DSQ high-current socket	x	x			