WinTrans

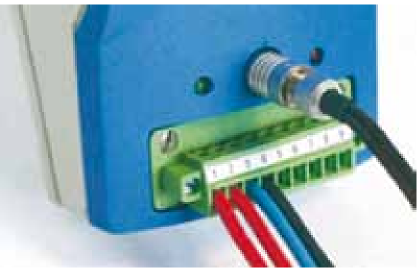
Test point mounted Wireless Remote Monitoring and Control System

Battery powered Remote Test Point Monitoring

Remote monitoring of cathodic protection system can only be economic and effective if simultaneous installation can be made at both test points and rectifier stations. This will reduce the amount of time and labour otherwise required for regular or manual monitoring.

MiniTrans has been specially designed for automated wireless remote monitoring of cathodic protection system operating parameters, such as ON- and Off-potentials, AC voltages, currents, microvolts, etc.

Advances in low-energy hardware and latest GSM radio technology allow 3 years of daily measurements and monitoring operations without a change of battery.



Input channels and serial PC interface port

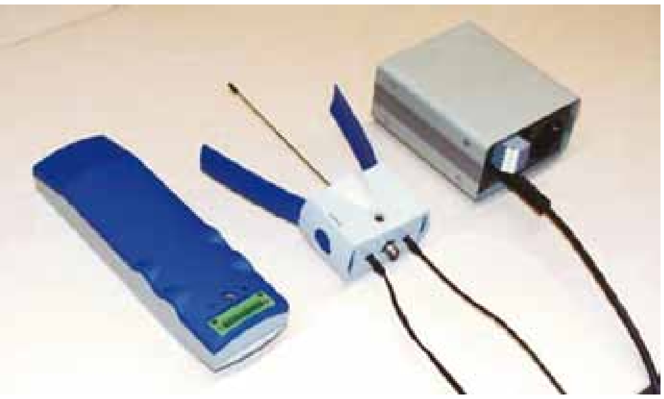
Low Cost Installation and Setup

MiniTrans installation is both simple easy and inexpensive. The antenna is specially designed to combine DCF-77 radio and (GSM) mobile phone technologies. It is very simply attached to the test station pole while the wireless sensor is mounted on top of the terminal board. Once installation is complete, connection to a remote monitoring network requires no more than the wiring of the input channels followed by a short test of functions.

DCF-77 and GSM antenna terminal

Multi-Channel Datalogger for remote-controlled Registration

In addition to remote monitoring, ***MiniTrans*** allows remote controlled, multi-channel registration.
MiniTrans thus offers indispensable functions to support measurement of for example stray currents and fault location.



Combined system consisting of sensor, antenna combination and external power supply unit

Time and Cost Saving Remote Programming

With its comprehensive remote programming and transmission functions, the ***MiniTrans*** allows technicians and operators to control all CP system functions from off-site locations (such as offices), thus reducing the time and labour otherwise necessary for site visits.
MiniTrans enables immediate, trouble-free response to changes in operational conditions of cathodic protection systems, such as measuring periods and volume.
In addition the to standard requirements of CP measuring techniques, ***MiniTrans*** continuously supervises and transmits internal data such as battery condition, DCF-77 and GSM signal strength, ambient temperature and synchronisation state.

Mains-powered Remote Monitoring of Rectifier Systems

In the past, reliable and trouble-free operation of cathodic protection systems depended on regular, manual supervision and monitoring of system functions, rectifier voltages and currents, etc., carried out on site.

MiniTrans remote monitoring of protection systems will allow your company to make a significant reduction to outlays of time and cost for manual and/or on site maintenance.

A mains-powered version of ***MiniTrans*** is also available for automated wireless remote monitoring and control of rectifier voltages and currents, ON and OFF- potentials and all other operating parameters of your catodic protection system.

A back-up battery ensures that the ***MiniTrans*** remote monitoring system remains fully functional even in the event of mains power failure, thus guaranteeing rapid detection of operating faults or problems in your CP sytem.

Remode controlled switching of rectifier system
with mains power supply unit

Controlling rectifier stations by mobile phone

Switching of rectifiers for Maintenance and Intensive Measurements

Previously, the carrying out of maintenance or intensive measurements required the time-consuming temporary installation of current interrupters. ***MiniTrans*** wireless sensor stations mean that this is no longer necessary.

Activation of rectifier switching and selection of switching cycles of single groups of rectifier stations can be carried out by remote control from an office or by mobile field operators.

Mobile Remote Control of Rectifiers by Mobile Phone (Cellphone)

MiniTrans wireless sensors are equipped as standard for remote operation by text message (SMS).

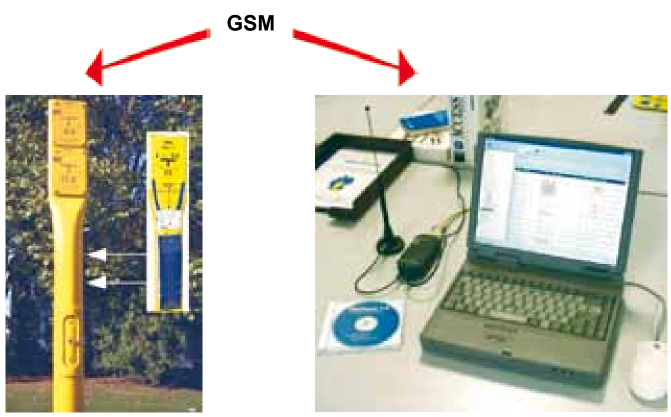
Keycodes can be sent by text message from any SMS-capable mobile phone to activate different switching modes and cycles.

Intelligent and off-site Remote Monitoring

The latest GSM radio technology allows the use of ***MiniTrans*** remote monitoring system locally and abroad and includes protection against data loss or manipulation.

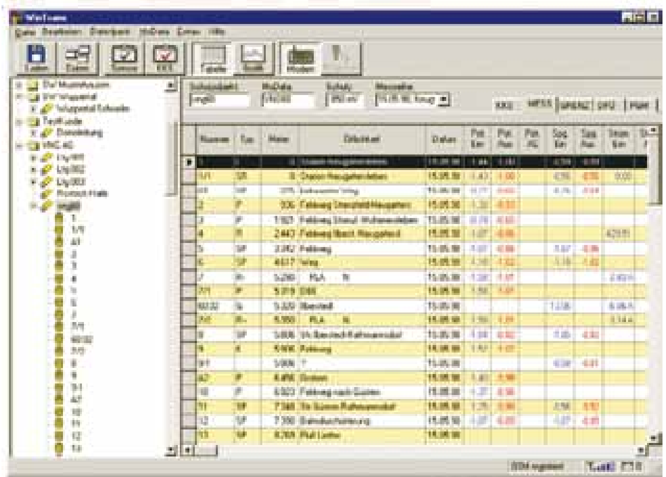
A GSM mailbox is used during automatic data back-up and transmission. This also allows every ***MiniTrans*** wireless sensor to store current remote operation functions and settings even if the control station (office-based PC, etc.) is offline.

This allows the simultaneous reception of measuring data and control of remote monitoring functions by up to 3 offices or mobile supervisory teams. Remote control and monitoring means that CP sytems and stations can be left unattended.



Software for Control and Evaluation of Remote Monitoring and Maintenance

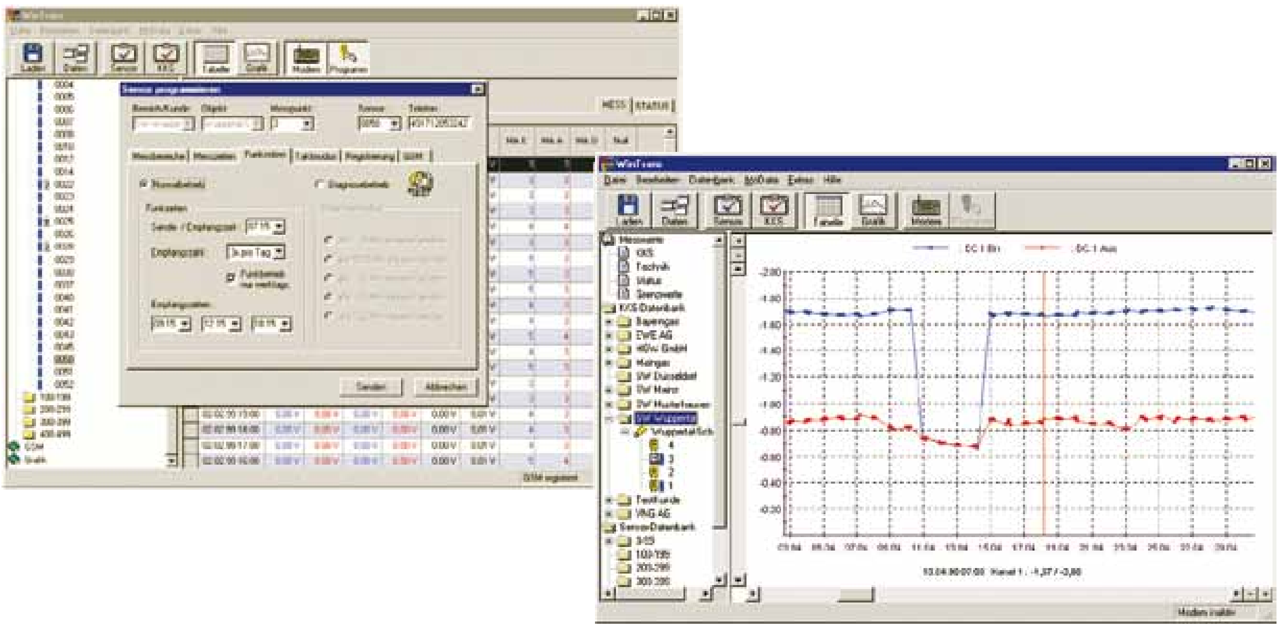
Remote Control and Remote Monitoring



Control and evaluation of all ***MiniTrans*** wireless sensors functions is carried out using ***WinTrans*** software.

All current remote monitoring operation parameters, such as measuring ranges, measuring periods, radio transmission and switching cycles are controlled by ***WinTrans software*** and transmitted to ***MiniTrans*** wireless sensors.

WinTrans uses a powerful, comprehensive database which has been specially designed to meet all standard CP system monitoring requirements. This can also be expanded according to enduser specifications to control all CP test points and rectifier stations.



Intelligent Remote Monitoring within Network

A reduced number of components for intelligent, low maintenance remote monitoring systems.

Test points and rectifier stations can be remotely controlled and monitored from your office. All you need is a PC or a notebook with installed ***WinTrans*** software and a ***WinTrans*** radio modem with external radio antenna.

Linked with a network gives you easy and convenient access to all information about your CP system test points and rectifier stations.

Technical Data

Description	Battery operated wireless sensor for radio-controlled monitoring and monitoring of CP measuring data and for remote switching of rectifier station
Measuring Inputs	2 x DC (with high AC attenuation) 2 x AC (parallel to DC channel measuring) 1 x µV (with high AC attenuation)
Memory	32 KByte Program / 96 KByte Data
Interface	9600 Baud serial for programming and supervision on installation site
Timer	DCF-77 synchronised real time clock with supply voltage change over and active temperature compensation
Timer Deviation	50 ms max. at 12 DCF receiver sequences / day (between -20°C and 60°C)
Switching Load Output	30 V / 0.1 A / 30 (higher load with external power supply unit)
Wireless system	Internal radio modem for GSM networks at 900 MHz
Antenna	Special antenna combination for DCF and GSM radio application for test point mounting or rectifier station installation
Program Updates	Wireless via remote transmission or direct via serial interface
Calibration control QM	Via serial interface with notebook on site
Battery Power Supply	Lithium battery pack 7,2 V / 13 Ah (uninterrupted data safety during battery change)
Mains Power Supply (optional)	External power supply unit with slave relay control
Dimensions / Weight	
Wireless sensor	65 x 240 x 40 mm (W x H x D) / 480 g (incl. Battery)
Antenna	75 x 60 x 40 mm (W x H x D) / 170 g (excl. Antenna rod)

Measuring Ranges

DC Voltage	Channel 1 + 2
	Range / Resolution ± 1000 mV / 0.1 mV ± 10 V / 1 mV ± 150 V / 15 V
Input Impedance	> 2 MΩ
Damping at 16.6 Hz at 50.0 Hz	 60 dB (factor 1.000) 100 dB (factor 100.000)
AC Voltage	Channel 1 + 2
	Range / Resolution 1 V eff. / 0.2 mV 10 V eff. / 2 mV 250 V eff. / 50 V
Input Impedance	> 2 MΩ
Frequency range	15 - 500 Hz
Microvolts	Channel 3
	Range / Resolution ± 100 mV / 1 µV
Input Impedance	> 200 kΩ
Damping at 16.6 Hz at 50.0 Hz	 60 dB (factor 1.000) 100 dB (factor 100.000)
Zero calibration	Automatic before measurement

Remote Monitoring / Switching of Rectifier Station

Monitoring facilities	2 DC channels On / Off (e.g. potential and protection tube) 2 AC channels (e.g. potential and foreign pipe) 1 µV channel On / Off (e.g. pipe current or rectifier current)
Measuring periods Mode normal Mode diagnosis	 Max. 4 complete on and off measurements / day (timer free programmable) 5, 10, 30, 60 or 120 min
Formation of mean value	Freely programmable (without or 1, 2, 4 or 8 min)
Switching options Permanent On Measuring Cycle Permanent Cycle Permanent Off	 e.g. in case of interface measurements Standard setting at remote monitoring e.g. 12/3 or 4/2 for intensive measurement For pipe repair
Radio periods Mode normal Mode diagnosis	 Max. 4 complete on- and off measurements / day (timer freely programmable) Every 5, 10, 30, 60, or 120 min
Status monitoring DCF-77 Signal Synchronisation Radio signal Battery state Main power supply Temperature Zero calibration	 Quality and reception status Timer deviation in ms Quality and reception reports Remaining capacity and operational time Mains failure indicator Temperature measurements Monitoring measurements accuracy
Remote programming	Remote programming of all settings and measuring features.
Battery life span Mode normal Radio on weekends off	 Approx. 2.5 to 3 years Approx. 3.5 to 4 years

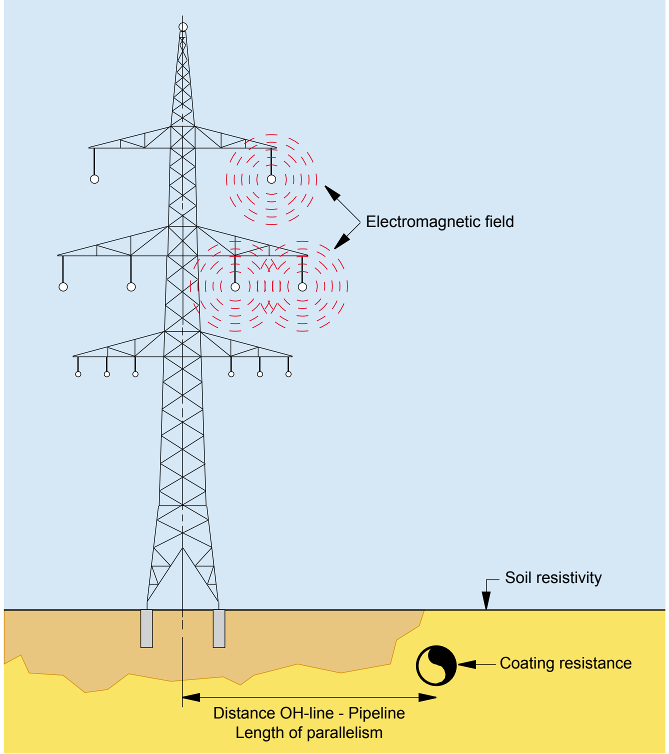
Registration / Datalogger

Channels	2 DC, 2 AC, 1 Microvolts
Sampling Rate without microvolt measurements with microvolt measurements	 0,5 s, 1 s, 2 s, 5 s, 10 s, 30 s 2 s, 5 s, 10 s, 30 s
Measuring values memory	ca. 50.000 values
Programing	Number of channels Measuring range Sampling rate Start-up Terminal time
Data Transmission	Wireless by radio or direct via serial interface
Remote Programming	Remote programming of all features
Battery Life Span	Approx. 80 single channel recordings at 1s sampling rate over 6 h (incl. radio transmission)
Zero calibration	Automatic during registration

Pipeline Routing

There are many important points to be considered when selecting the right pipelines routes. These include environmental impact, legal requirements for planning permission and land use, as well as constraints from nearby housing or industrial facilities. as result it is often necessary to use already existing high voltage overhead power supply corridors.
Inevitably results in crossings and parallel locations of various routes which can lead to interference and an increased of danger of high voltages to personnel and equipment. Technical measures needed to reduce this potential danger to personnel and equipment will require additional planning and expenditures.

Reduction of this potential danger for personnel and equipment is only reached by high technical and econonomical efforts.



Calculations of induced contact voltages

The basic elements of calculating induced contact voltages and the necessary preventive/corrective measures are well known. Previously, the conventional method was to use a combination of estimations, empirical values and calculations. We have developed a special computer to calculate induced contact voltages. It also allows calculation of close proximity sections and the optimisation of any required earthing and mitigating measures.

The HVIC program allows a computer simulation of overhead line and pipeline configurations so that any changes in the operating parameters can be considered for critical sections.

Gathering Information

Information gathering is the most important part in solving of high voltage interference problems.

The information requiredincludes:

- The layout drawings of pipelines and high voltage overhead lines routes.
- Top-view scale drawings or maps of the entire geographical area of interest, showing all conductors (pipelines) under study in sufficient detail, as well as any other major installations.
- High voltage overhead line and pipeline details include:

Pipeline data

- Material specifications
- Outside diameter
- Coating resistance
- Buried depth
- Specific soil resistivity

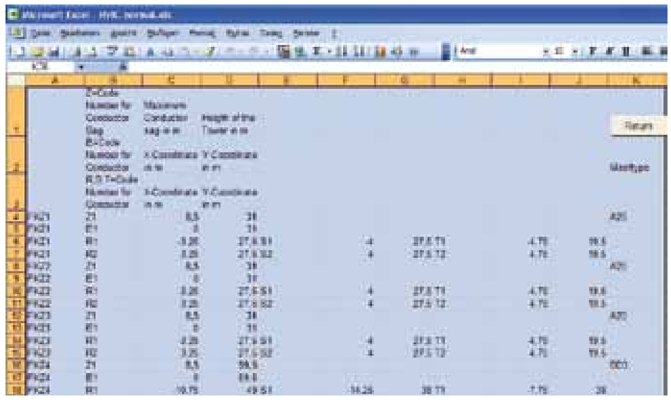
High voltage overhead line data

- X-Y Tower coordinates of conductors
- Maximum conductor sag
- Height of towers
- Type of conductors
- Type of earthwire on top
- Maximum operating current
- Operating frequency
- Short circuit earth fault current
- Neutral point of system

PC-based Computer Program

The PC-based computer program includes comprehensive electromagnetic coupling equations with an easy-to- use interface format to enable both operating and short circuit conditions to be calculated for up to five unbonded pipelines co-located with up to twenty power transmission line circuits.

The program also provides enhanced analysis and assessment of pipeline bonding connections and pipeline earthing measures for both operating and short circuit mitigation. The format developed for this program makes many of the computational functions and much of the data input automatic for the user, thus leading to considerable simplification in program usage.
Data input for few computer screens are required to fully exercise the program.



Example of data input for calculation by using Microsoft Excel™

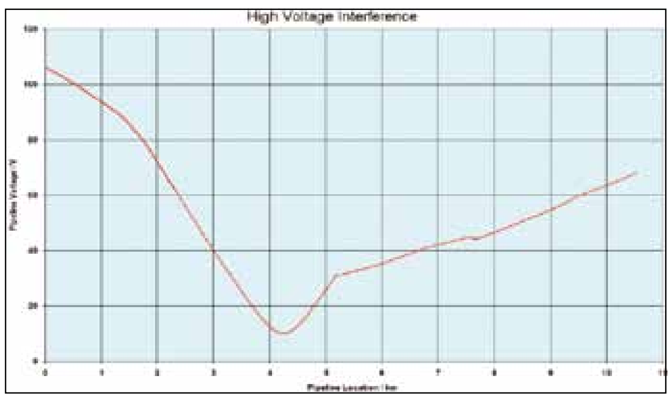
Advantages

The software considerably reduces necessary working time and operational costs involved in solving AC induced problems, preparing studies of inductively coupled interference, design and planning of new cathodic protection systems for co-located pipelines and overhead voltage transmission lines, planning of crossings and right-of-way and risk assessment.
The program can be used by pipeline engineering staff and contract consultants to reduce necessary engineering costs and time while improving the safety and integrity of cathodic protection design.

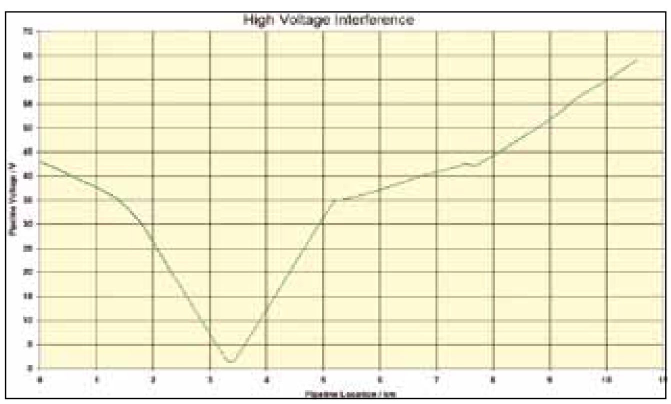
Calculation results caused by overhead line **operating currents** without any earthing measures

Standards and Guidelines

In 1977, the NACE recognised the problem of induced AC on pipelines and issued a Standard Recommended Practice to control corrosion and safety issues.
In 1995, this standard was updated and re-issued as Standard RP-01-77-95 „Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems“.
The Canadian standard is CAN/CSA-C22.3 No. 6-M91 „Principles and Practices of Electrical Coordination between Pipe Lines and Electric Supply Lines“.
Standards also exist in Europe, such as DIN VDE 0141 (Beuth-Verlag, Berlin, 1976).
The NACE and Canadian standards recommend that the potential on a pipeline from AC be reduced to less than 15 V AC. European standards recommend a reduction to less than 60 V AC.



Calculation results caused by overhead line **short circuit currents** without any earthing measures

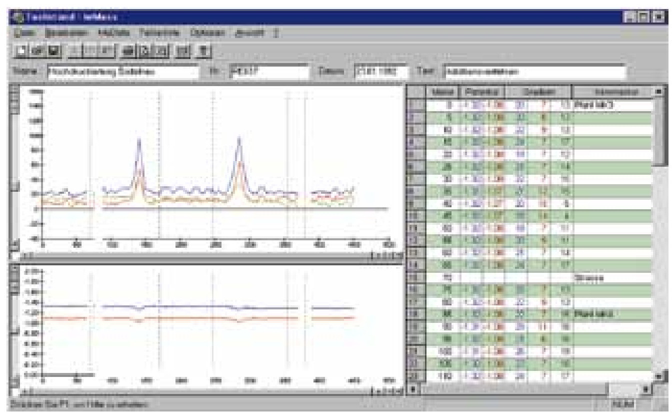


Calculation results caused by overhead line **operating currents** with earthing measures (U_{max} < 65 V according to German Standard)

Analysis of the external corrosion of buried pipelines is made using pipe-to-soil potential measurements. Pipe-to-soil potentials are usually measured at fixed test points spaced between 1-5 km along a pipeline. However, since such measurements are only valid at the location of the reference electrodes, there is a lack of reliable information about the CP status elsewhere along the pipeline.
Considerable deviation in soil resistivity, interference and other factors can cause corrosion at intermediate locations even though the test points indicate favourable data. If the distance between the test points is decreased, the survey will provide more accurate data about CP conditions along the pipeline. This is why we have developed the Close Interval Potential Survey (CIPS), an intensive survey which allows potential measurements to be taken at intervals of 5 metres or less.

Reasons to use closed interval potential survey - CIPS

It is obvious that a manual survey of pipe-to-soil potentials at such close intervals can be neither practical nor economic, especially if a long distance transmission pipeline is to be inspected. Even if stripchart recorders are available, such a survey woud be extremely time consuming. Thus a faster and more reliable method is a better alternative.
CIPS overcomes such problems by automatically recording, storing, calculating and displaying measurement data. This can be presented in a table or a graphic.



Required hardware

- MoData2 including handheld PC Itronix fex21
- MoData2 scope of delivery package

Required software

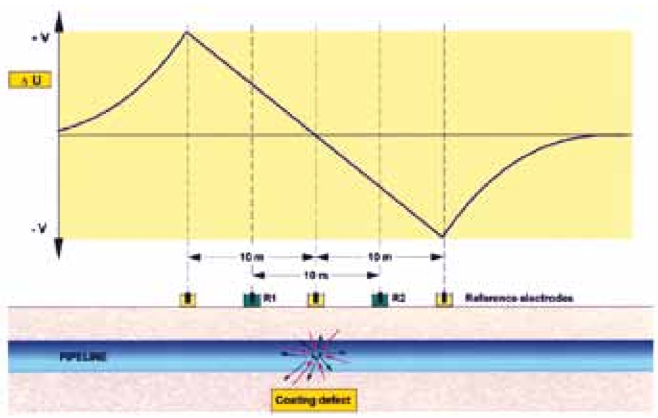
- NaMobil 3.0
- IntMobil 3.0
- WinTrans 1.0
- IntMess 3.0

The MoData2 Multifunction Instrument is used for field recording and display of pipe-to-soil potentials and voltage drops in a cathodic protection system. These are also stored in the MoData2`s internal memory.
4 measuring methods are directly integrated into the mobile software package:

- 2-electrode method
- 3-electrode method
- Additions method
- IFO method

IFO method

IFO (Intensive Fault Location) is the preferred choice for use with new pipelines with intact coatings and a relatively small number of defects.
IFO detects faults only and does not allow measuring of potentials. For checking the potential at a test point during IFO measuring, it is necessary to switch to either the 2 or 3-electrode method.
In order to optimise the measurement of even the smallest voltage differences, it is common to increase the feeding current of the rectifier during measuring with the IFO method, as this produces a higher potential gradient at fault locations.



Description of the measuring method

The IFO method measures the ON and OFF voltage drops along pipelines. For this, two electrodes are placed at ground level along the line at distances of 5 or 10 m. The standard step size is 5 m, meaning that both electrodes will be shifted by another step (of 5 m) in the measuring direction after each reading has been completed.
For an evaluation of the values of the IFO measurement, the difference between the measured ON and OFF voltages is compared. An increment of the voltage differences followed by a reversed polarity indicates a possible defect location.

Note regarding the electrode placing

Using a distance of 10 m between the two moving electrodes offers advantages when measuring small voltage drops. Using a distance of 5 metres allows determination of absolute voltage gradient by simply adding up the voltage drops measured.

Measuring array: IFO

The measuring array for the IFO measurement is very simple to implement: Just connect terminal channel B and the ground to the 2 electrodes to be used.

2-electrodes method

This is the most frequently applied method for intensive measurements.
The ON and OFF potentials and the respective voltage gradients are measured at each individual measuring point.
Measurement of the ON and OFF potentials is performed by means of a direct connection of the measuring contacts, while measurement of the ON and OFF voltage gradients takes place perpendicular to the pipeline axis at a distance of about 5 to 10 m. To ensure a reliable comparison of the voltage gradient values, measurements must be taken at a constant perpendicular distance to the pipeline.

Advantages of the 2-electrode method

Since this direct way of collecting measuring values does not require any adding up, it is very easy to perform.

Disadvantages of the 2-electrode method

As this method requires a direct connection to the test point, it may require rather large cable lengths, i.e. at least half of the distance between the two test points.
Moreover, taking the perpendicular measurements of the voltage gradients requires a constant and relatively large distance to the pipeline axis (about 10 m), which means that difficulties may arise in uneven terrain, residential or industrial areas.

Measuring array: 2-electrode method

Applying this method requires a proper connection to the test point. For measuring potentials, channel A of the MoData2 multi task converter (MTC) is connected to the test point.
The lateral measuring electrode connected to channel B of the MoData2.
The reference electrode on top of the pipe axis is connected to the black ground terminal of the MTC.

3-electrodes method

The 3-electrode method is an extension of the 2-electrode method. In contrast to the latter, the 3-electrode method allows measurement of two voltage gradients symmetrically along both sides of the pipe axis.
The MoData2 system thus allows the calculation of IR-free potentials according to the so-called extrapolation method by simultaneously measuring the potential and the two voltage gradients on the left and right sides of the pipe.

Advantages of the 3-electrode method

This method offers considerable advantages when evaluating intensive measurement data of parallel pipelines. Interfering external voltage gradients on one side of the pipe axis can be suppressed during the evaluation of the measurement data thus allowing a more accurate data evaluation.
The 3-electrode method is often used for remeasurement of pipe locations where a previous IFO method indicated a flow. In most cases measurement of the left and right side voltage gradients combined with a calculation of the IR-free potential allows a more precise assessment of the cathodic protection at the flawed pipe spots than would be possible with other measurement methods.

Disadvantages of the 3-electrode method

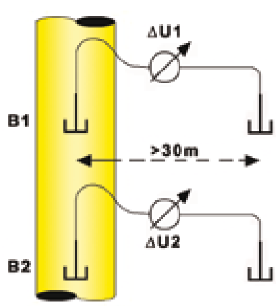
The extensive measuring array requires a relatively large number of staff to operate the system. The double-sided measurement of the voltage gradients at the largest possible and constant electrode distance (e.g. 20 m between the left and the right electrode) may result in slow daily progress over areas of difficult terrain.

Measuring array: 3-electrode method

Applying this method requires a proper connection to the test point. For measuring potentials, channel A of the multi task converter (MTC) is to be connected to the test point.
The lateral measuring electrodes are to be connected to channels B and C of the MTC. The reference electrode on top of the pipe axis is connected to the black ground terminal of the MTC. Compensation of electrode differences will be needed to ensure reliable calculation of IR-free potentials.

Addition method

The addition method uses simple longitudinal voltage measurements and a subsequent calculation of potentials and voltage gradients. The addition method is based on the assumption that the voltage between two reference electrodes being installed on remote ground is more or less 0 mV. This means that, for instance, during a voltage gradient measurement the position of the laterally mounted reference electrode is irrelevant so long as it is installed on remote ground.

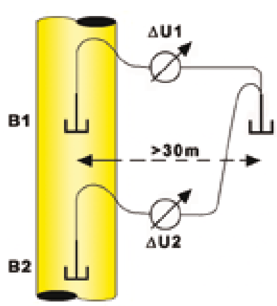


Mathematically expressed:

[1] UA1 - UA2 = 0
[2] UA1 = UA2
(considering remote ground)

Thus:

[3] UB1 - UA1 = UB1 - UA2
[4] UB2 - UA2 = UB2 - UA1



Assumption:

[5] $\Delta U1 = UB1 - UA1$
[6] $\Delta U2 = UB2 - UA1$

resulting in equation (for UA1):

[7] $\Delta U1 - UB1 = \Delta U2 - UB2$
[8] $0 = \Delta U1 + (UB2 - UB1) - \Delta U2$

Thus:

$$\mathbf{\Delta U2 = UB2 - UB1 + \Delta U1}$$

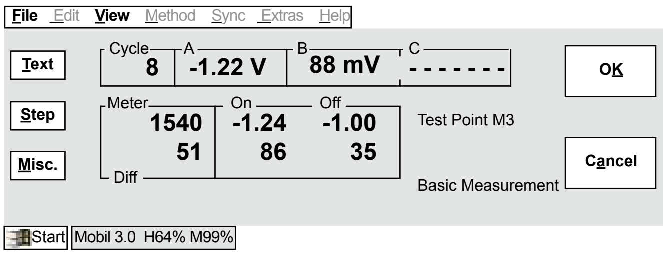
The laterally positioned reference electrode may be installed on remote ground.

This means that the voltage gradient ΔU2 can be calculated by taking the differential voltage UB2 - UB1 (voltage drop alongside the pipeline) and adding ΔU1 (basic voltage).

The procedure for calculating the potential is similar.

Basic value collection
Prerequisites for any calculation are the so-called basic values that are to be collected when commencing the measuring and again whenever further measuring contacts are being reached.

Each time basic values are measured, IntMobil shows „Basic Measurement“ beneath the line for the text entry on the display of the current measuring mode.



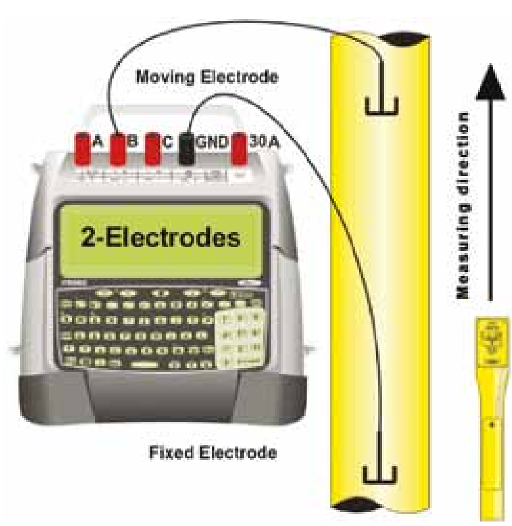
Basic values are taken using the 2-electrode method. Please refer to for the measuring array.

Basic values may be taken and calculated at any test point. This results in a higher accuracy of the calculation of further potentials and voltage gradients.

Notes regarding the addition method:
When taking basic values at stray current-influenced pipes, problems may arise during the adding-up procedure. The basic values may drift during the intensive measurement thus leading to incorrect values.

Furthermore, it must be noted that upon each electrode shifting larger electrode differences may lead to significant step changes of the voltage gradient and/or potential values. Therefore, keep the number of electrode shifts as small as possible.

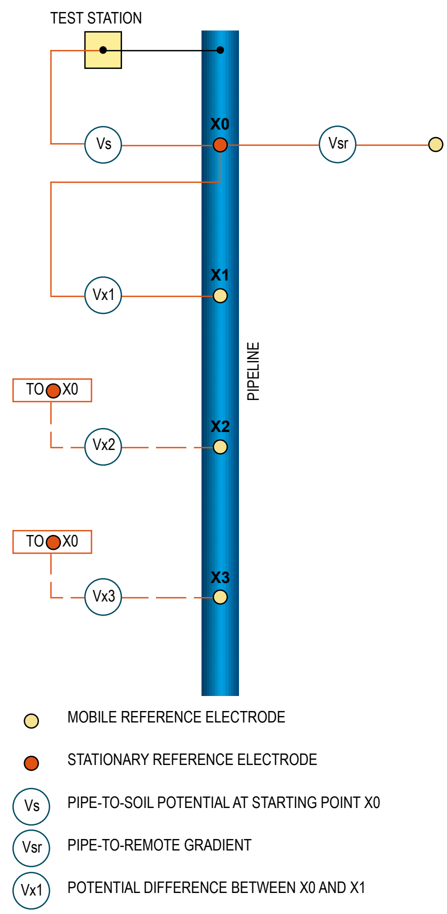
Measuring array: Addition method
After the measurement of basic values has been completed, the so-called „fixed electrode“ has to be placed exactly where the reference electrode was positioned during the basic measurement of voltage gradients and potentials. The so-called „moving-electrode“ has to be placed according to the step size along the pipeline.



After a measurement has been completed, the moving electrode will be repositioned by one step size in the measuring direction along the pipeline. The fixed electrode remains at its location and will only be moved and repositioned after an electrode shift or in the course of a new basic measurement.

Shifting electrodes
The fixed electrode remains positioned during the basic measuring value collection. During the progress of the measuring procedure increasingly larger cable lengths will be required between the fixed electrode and the multi task converter (MTC). If an extension cable is unavailable, the fixed electrode has to be shifted to make further intensive measurements possible.

BASIC METHOD FOR MEASUREMENT OF POTENTIAL



IntMobil stores the latest voltage gradient and potential values measured during the electrode shift and uses these values as new basic values for the addition of measured longitudinal voltages between the fixed and the moving electrode.

Note regarding the shifting of electrodes
Shifting electrodes is not only helpful after the available cable length has been fully used, but also when crossing railway lines or roads.
Collect the measuring values beyond the railway line. Afterwards, shift the electrodes as described above with the fixed electrode being positioned beyond the railway line.
Cabling across the obstacle will then be necessary for the period of one measurement only.

COMPUTER SOFTWARE

Calculation of cathodic protection systems

German Cathodic Protection GCP

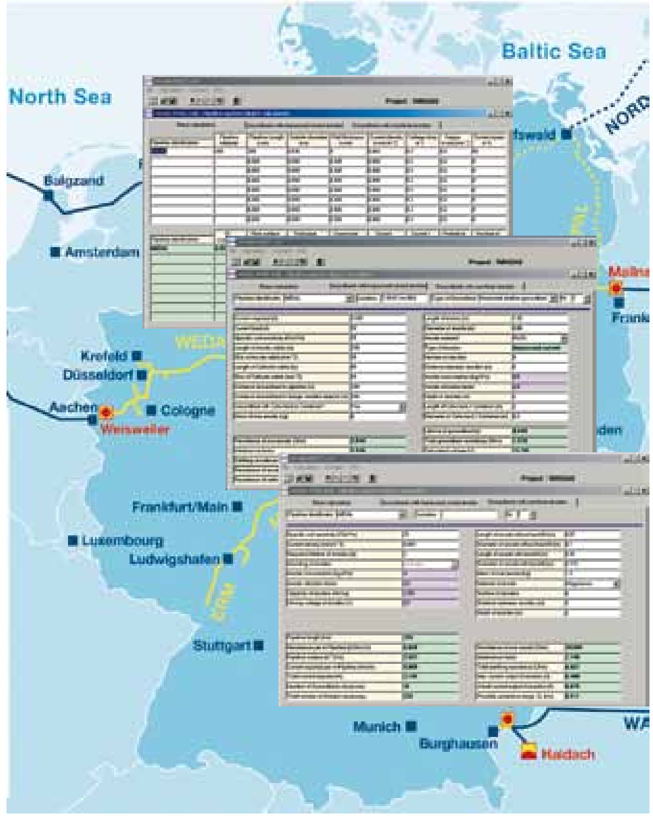
Document No.: 12-410-R1

Our company has considerable experience in the continuous development of user-oriented software. Our *CP-CALC™* software package has been specially designed and engineered for various kinds of cathodic protection projects.
The CP-CALC™- calculation software package - has been developed to solve planning problems encountered in the design and engineering of cathodic protection systems for different types of structures.

CP-CALC™ is an award winning calculation software package for professionals who need simple and precise calculations for cathodic protection systems.

CP-CALC™ provides a whole array of time saving operations for improved efficiency and better performance.

System requirements: Windows™



CP-CALC: PIPELINES

- current requirement calculation
- protective range calculation
- stations with horizontal shallow groundbed
- stations with vertical shallow groundbed
- stations with open hole groundbed
- stations with closed hole groundbed
- galvanic anode systems
- temporary protection with magnesium anodes
- current density as a result of drain test
- offshore pipes with bracelet anodes

CP-CALC: INDUSTRIAL PLANT AREAS

- current requirement calculation
- stations with horizontal shallow groundbed
- stations with vertical shallow groundbed
- stations with shallow sub-groundbeds
- stations with open hole groundbed
- stations with closed hole groundbed

CP-CALC: OFFSHORE STRUCTURES

- current requirement calculation
- galvanic anode system
- with aluminium, magnesium, zinc anodes
- impressed current system

CP-CALC: STORAGE TANKS, INTERNAL

- current requirement calculation oil tank
- current requirement calculation water tank
- galvanic anode system
- with aluminium, magnesium, zinc anodes

CP-CALC: PRODUCTION WELL CASINGS

- current requirement calculation
- stations with open hole groundbed
- stations with closed hole groundbed
- stations with horizontal shallow groundbed
- stations with vertical shallow groundbed
- current drain (E-log J) test

Well Casing Potential Profile (WCPP)

Electrical potential is the most important factor in cathodic protection in determining the degree of protection required by a buried or submerged metal structure.
The necessary degree of protection is indicated by the potential difference measured against a reference electrode placed in the surrounding medium.

The most commonly used reference electrode is the saturated copper/copper sulphate ($Cu/CuSO_4$) electrode. Potential differences of at least -0.85 V / $Cu/CuSO_4$ are widely accepted as standard for the protection of steel in soil or water. The potential difference should be measured with the reference electrode placed as near as possible to the structure to minimise voltage drop (IR) errors caused by cathodic protection current flowing through the medium.

A well casing is physically and electrically similar to a vertically installed pipeline. The decrease of current and voltage with distance from the drain point of the cathodic protection station is like that along bare pipeline.

However, the cathodic protection test methods applicable to pipelines are not suitable to well casings. Whereas test leads can be installed at any point on most pipelines to measure potentials and currents, such measurements on well casings can only be carried out at the well head.

We have developed WCPP, a specialist software package for well casing potential profile calculation.

The software factors in the physical data of the well casings and electrical measurement of potentials and currents at the well head, allows calculation of potentials and currents at other points along the depth of the casing.

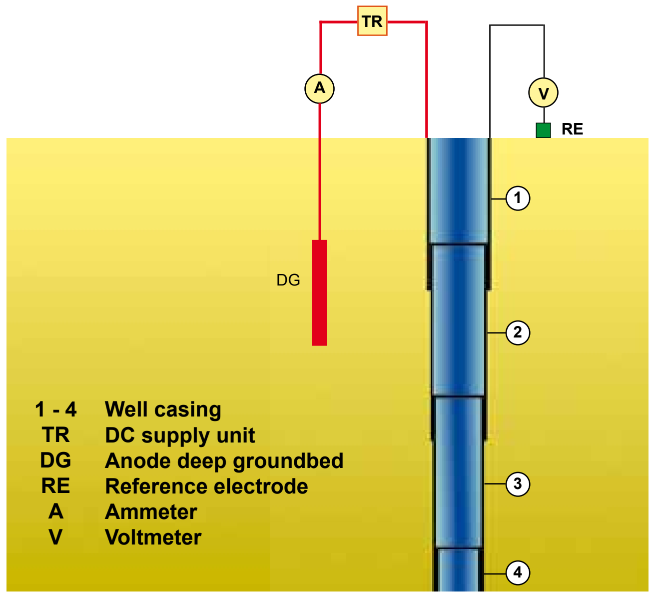
Variables which can be used are as follows:

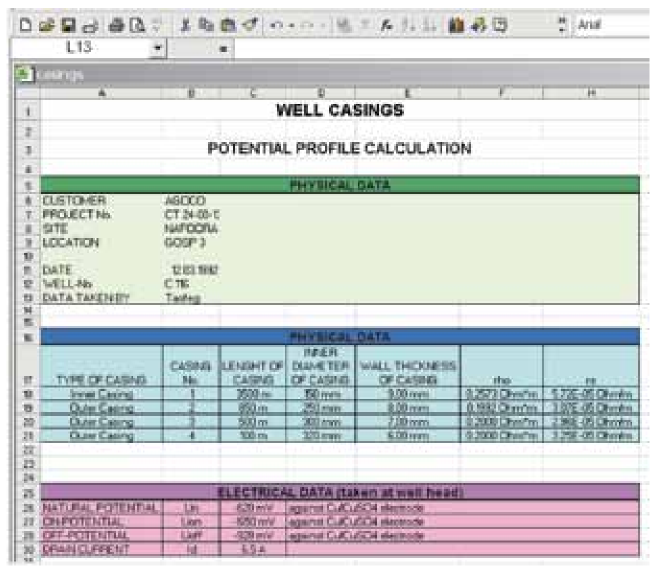
Physical

number of casings	: n
length of casings	: L
diameters of casings	: D
specific weight of casings	: W

Electrical variables measured at the wellhead

natural potential	: E nat
ON potential	: E on
OFF potential	: E off
drain current	: I





WELL CASINGS

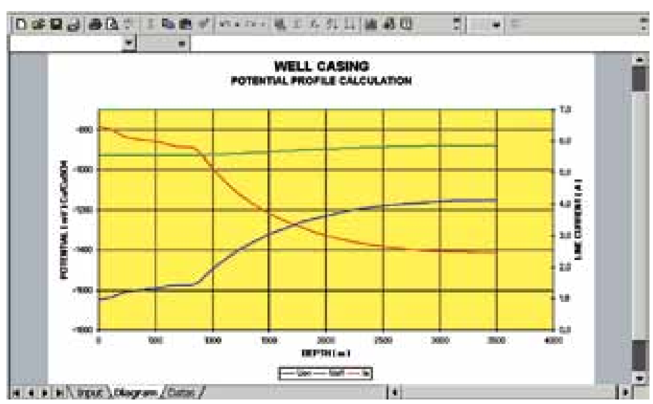
POTENTIAL PROFILE CALCULATION

PHYSICAL DATA	
CUSTOMER	ASCOO
PROJECT No	CT 24-03-C
SITE	NAFOORA
LOCATION	GOSP 3
DATE	12.03.1992
WELL-No	C 16
DATA TAKEN BY	Tarfeg

TYPE OF CASING	CASING No	LENGHT OF CASING	INNER DIAMETER OF CASING	WALL THICKNESS OF CASING	rho	rs
Inner Casing	1	3500 m	150 mm	9.00 mm	0.2523 Ohm*m	5.72E-05 Ohm/m
Outer Casing	2	850 m	250 mm	8.00 mm	0.1932 Ohm*m	3.07E-05 Ohm/m
Outer Casing	3	500 m	300 mm	7.00 mm	0.2000 Ohm*m	2.96E-05 Ohm/m
Outer Casing	4	100 m	320 mm	6.00 mm	0.2000 Ohm*m	3.25E-05 Ohm/m

ELECTRICAL DATA (taken at well head)			
NATURAL POTENTIAL	Un	-620 mV	against CuCuSO4 electrode
ON-POTENTIAL	Uon	-950 mV	against CuCuSO4 electrode
OFF-POTENTIAL	Uoff	-920 mV	against CuCuSO4 electrode
DRAIN CURRENT	Id	6.5 A	

Input Menu



Potential Profile Diagram

Potential Output Data
can be printed or displayed on screen.