VM15

Parameter setup

Installer manual
VM15 – Parameter setup

9UMEN1505-1200
Release: 220128

VM15 Parameter setup

1. Balancer [type BN]

1.1. Option

ID	Parameter	Description
	Operating mode **[AUTOMATIC]**	**AUTOMATIC:** The device works both in manual mode (controlled by the operator) and in automatic mode (controlled by the PLC/CNC) **SEMI-AUTOMATIC:** The device executes the automatic cycles under operator control **MANUAL:** The device works in manual mode, performing the manual guided balancing procedure (pre-balancing) **PRE-BAL:**
	Max vibration factor **[x1]**	Coefficient to adjust the parameter “Max vibration” **x1** integer number. i.e. 5 mm/s **x100** fractional with 2 decimal unit. i.e. 5,00 mm/s
	Extra power disable **[OFF]**	Reserved

1.1.1. HW CONFIGURATION

ID	Parameter	Description
	AV Monitor **[OFF]**	**OFF:** Disabled **ON:** Enable AV Monitor commands
	Power-on PC **[OFF]**	**OFF:** Disabled **ON:** turn on the collector for internal check
	Extra Power while Power-on PC **[OFF]**	**OFF:** Disabled **ON:** Enable extra power on the collector if Power on PC is enabled
	Extra Power disable **[OFF]**	**OFF:** Disabled **ON:** Enable extra power on the collector
	Dbg: External RAM **[OFF] (read only)**	**OFF:** Disabled **ON:** Enable check for external RAM presence
	Dbg: FRAM bank #2 **[OFF] (read only)**	**OFF:** Disabled **ON:** Enable check for external FRAM presence

1.2. Setup

1.2.1. INPUT - OUTPUT

ID	Parameter	Description
	Handshake management **[OFF]**	Mode to implement the I/O interface (both digital I/O and Profibus) **OFF** = Without signals handshake management **ON** = With signals handshake management For details refer to Signals Interface
	Output B2 pin 3: echo rpm prescaler **[OFF]**	With the option "**Echo rpm output = ON**", this value defines the operation of the digital output available on the B2 connector – Pin 3. The signal available on the digital output is square wave with 50% duty-cycle and a frequency equal to the rpm signal divided by the value entered.
	Output B2 pin 6 **[OFF]**	Reserved

1.2.1.1. B1 CONNECTOR

ID	Parameter	Description
	Output B1 pin 13 **[MOTORS ON]**	Pin 13 on connector B1 may assume the following meanings: **MOTORS ON** = the balancing head's motors are activated for moving the compensation weights **WORK** = Cycle in-progress
	Output B1 pin 14 **[SPINDLE STOP]**	Pin 14 on connector B1 may assume the following meanings: **SPINDLE-STOP** = Output is active if spindle speed is below the value programmed in the setup parameter "minimum rotation speed". **SPINDLE-RUN** = Output is active if spindle speed is above the value programmed in the setup parameter "minimum rotation speed". **WORK** = Cycle in-progress
	Output B1 pin 15 **[NOMINAL RPM]**	Pin 15 on connector B1 may assume the following meanings: **NOMINAL RPM** = The wheel has reached the condition of rpm at nominal speed. **WORK** = Cycle in-progress

1.2.1.2. OUTPUT LOGIC (access with password)

Changing this parameter requires entering the password "**1 3 4 8 9**".

ID	Parameter	Description
	Digital output logic **[NEGATIVE]**	**NEGATIVE** = Outputs active when the signal is at low level (0 V) **POSITIVE** = Outputs active when the signal is at high level (+24 V)

1.2.2. BALANCING HEAD [B4]

ID	Parameter	Description
	Neutral cycle mode **[STANDARD]**	Neutral masses execution mode **STANDARD**: The neutral masses cycle is executed in the standard mode foreseen for the installed balancing head. This operating mode warrants the maximum precision in the weights positioning. **FAST**: The neutral masses cycle is executed in a faster way but with less precision in the weights positioning.
	Balancing head **[CUSTOM]**	Indicates the type of balancing head controlled by the balancing card and defines a set of characteristic parameters of the selected head: **CUSTOM**: head with special and dedicated characteristics. (see CUSTOM BALANCING HEAD) **ADI-ADJ**: Internal type with NoLink collector **CDI-CDJ**: Internal type with NoLink collector **SDI-SDJ**: Internal type with NoLink collector **AHI-AHJ**: Internal HP type with NoLink collector **CHI-CHJ**: Internal HP type with NoLink collector **SHI-SHJ**: Internal HP type with NoLink collector **SDM-SDC**: External type with NoLink collector **SHM-SHC**: External HP type with NoLink collector **SDE**: External type with brushes collector **SDI**: Internal type with brushes collector

1.2.2.1. CUSTOM BALANCING HEAD

ID	Parameter	Description
	Driver voltage [V] **[12]**	Nominal voltage for supplying the motors of the balancing head.
	Max voltage [%] **[95]**	Maximum voltage that the motors of the balancing head can take without being damaged. It is a percentage of driver voltage.
	Min voltage [%] **[10]**	Minimum voltage for ensuring the movement of the weights, at least with the wheel stopped. It is a percentage of driver voltage.
	Min time for neutral positioning [s] **[10]**	Minimum time required to reach the neutral position. This parameter is used for diagnostic. If the neutral cycle is too fast, the balancing head can be locked and one or both motors can be in short circuit. In case that the neutral cycle fails, an alarm is issued to the PLC and the error icon  appears on screen in the status area.

1.2.2.1.1 DRIVER

ID	Parameter	Description
	Max current [mA] **[70]**	Current consumption limit which will ensure the correct operation of the motors of the balancing head. This parameter defines the threshold value for the control of current consumed in case of collision of the compensation weights, or blocked weights due to a damaged balancing head. In particular the exceeding of this threshold causes the inactivation of the motors' control circuit and the collision signalling (symbol '→I' or 'I←' in the area reserved for the motors).
	Current limit [mA] **[150]**	Peak current limit
	Max current prescaler **[1]**	Filter for weights collision detection
	Cue duration [ms] **[500]**	Time to mask the weights collision
	Ramp duration [ms] **[200]**	Delay time to reach the nominal voltage
	Max current correction [%] **[20]**	Coefficient to adjust the curent threshold depending on the supplied voltage

1.2.3. COLLECTOR [B4]

ID	Parameter	Description
	NoLink control **[START]**	Indicates the mode for optimizing the coupling between transmitter and receiver in the NoLink type of no contact collector system. **CONTINUOUS**: Transmitter and receiver are normally coupled, other than in exceptional situations (e.g. Maintenance). **RE-START**: Transmitter and receiver are only coupled when starting automatic cycles (e.g. balancing, weights to neutral) or manual moving of the motors. The optimization is performed at each new cycle. This mode can be used in case of machines where the balancing cycle is executed by moving the spindle axis to a specific position where the static part of the collector is located. **START**: Transmitter and receiver are only coupled when starting automatic cycles (e.g. balancing, weights to neutral) or manual moving of the motors. **ENABLE**: Transmitter and receiver can be permanently coupled and ready under an enable signal issued by PLC. ***Note**: In a system that features the touch detector AE sensor integrated in the balancing head, this parameter must be set as "START" or "RE-START".*
	NoLink collector type **[CUSTOM]**	**AXIAL**: NoLink collector (classic style) **AXIAL 2**: **RING**: NoLink ring collector **CUSTOM**: NoLink collector with dedicated setup (see CUSTOM NOLINK COLLECTOR)

1.2.3.1. CUSTOM NOLINK COLLECTOR

ID	Parameter	Description
	F nominal [Hz] [5640]	Nominal coupling frequency
	F max [Hz] [6400]	Max coupling frequency
	F min [Hz] [5400]	Min coupling frequency
	F step ± [Hz] [10]	Frequency step on coupling optimization procedure
	Frequency adjustment delay [s] [1.5]	Steady state delay on frequency optimization procedure
	Vs nominal [V] [7.0]	Nominal voltage on static part
	Vs max [V] [10.0]	Max voltage on static part
	Vs step ± [V] [0.2]	Voltage step on voltage regulation procedure
	Is max [mA] [600]	Max current on static part
	Is RMS filter [300]	RMS filter on the current of the static part
	Vr nominal [9.0]	Nominal voltage on rotating part
	Rotating part startup delay [s] [2.0]	Startup delay on rotating part

1.2.3.2. RF CHANNEL TUNING

RF channel tuning procedure to estabilish the correct communication betwen the static and the rotating part of the collector.

ID	Parameter	Description
	RF channel **[OFF]**	Define which are the targets of the new RF tuning. **OFF** : disabled **SP+RP** both static and rotating part **SP** : static part only When the value is not equal to OFF, at the first startup the system will execute the tuning procedure. Then, if “Save new tuning” = ON the procedure will terminate with data saving and this parameter will change automatically to OFF. Otherwise it remains active for the next test.
	Save new tuning **[OFF]**	**OFF** : the new configuration is not saved while the procedure ends.. To be used for test only. **ON** : the procedure ends with data saving.
	Change RF channel **[0]**	Channel number for the new tuning [0..255]. The gap between two adiacent channels is approx. 200 Hz.

The no-link colector is pre-configured to guarantee the communication between the rotating part and the static part on RF channel No.0.
In case of:

a) Communication problem due to disturb caused by other no-link devices installed in the near closeness.
b) Static or rotating speare parts installation

It is possible to change the communication channel. To execute this operation please follow the below procedure:

CASE (1): The system communicates correctly but is disturbed from other no-link devices installed in the near closeness.

In this case a chenge of RF channel No. is needed.

a) Set “RF channel = SP+RP”
b) Set “Change RF Channel = NEW NUMBER (example No.5)”
c) Set “Save new tuning = OFF”
d) Exit from parameters page
e) Execute a manual command to the balancer. Example “Move Motors ” and check the correct functioning.
f) If a stable condition is not reached repeat from point a) changing again the channel No.
g) As soon as a stable condition is reached, go back to the RF parameters menu and set:
   “RF channel = SP+RP”
   “Change RF Channel = NEW NUMBER (example No.5)”
   “Save new tuning = ON”
h) Execute a manual command to the balancer. Example “Move Motors ” and check the correct functioning.

NOTE: Do not shut down the system while perforning the above described operations, otherwise a repeat of the procedure is needed!

CASE (2): Colector fixed part replacement (spare part)

The no-link colector is pre-configured on the RF channel No.0.

a) If parameter “Change RF Channel = 0”, no precedure is required to be performed. The system has to work correctly.

Otherwise:

a) Set “RF channel = SP”
b) Leave “Change RF Channel = SET VALUE”
c) Set “Save new tuning = OFF”
d) Exit from parameters page
e) Execute a manual command to the balancer. Example “Move Motors ” and check the correct functioning.
f) Go back to the RF parameters menu and set:
“RF channel = SP”
“Change RF Channel = SET VALUE”
“Save new tuning = ON”
i) Execute a manual command to the balancer. Example “Move Motors ” and check the correct functioning.

CASE (3): Colector rotative part replacement (spare part)

The no-link colector is pre-configured on the RF channel No.0.

b) If parameter “Change RF Channel = 0”, no precedure is required to be performedThe system has to work correctly.

Otherwise

a) Set “RF channel = SP”
b) IMPORTANT: Take note of the “Change RF Channel” value
c) Set “Change RF Channel = 0”
d) Set “Save new tuning = ON”
e) Exit from parameters page
f) Execute a manual command to the balancer. Example “Move Motors ” and check the correct functioning.
g) Go back to the RF parameters menu and set:
“RF channel = SP+RP”
“Change RF Channel = SET VALUE”
“Save new tuning = ON”
h) Execute a manual command to the balancer. Example “Move Motors ” and check the correct functioning.

1.2.4. PICK-UP 1 [B5]

ID	Parameter	Decription
	Sensitivity [mV/g] **[325]**	Sensitivity of the vibration transducer, expressed in mV per acceleration unit. The acceleration unit “g” is equal to 9.81 m/s^2 .
	Power supply source **[ICP MD]**	Power supply source for the vibration transducer **VOLTAGE**: voltage source **ICP LO**: current source low level **ICP MD**: current source medium level **ICP HI**: current source high level

1.2.5. BALANCING

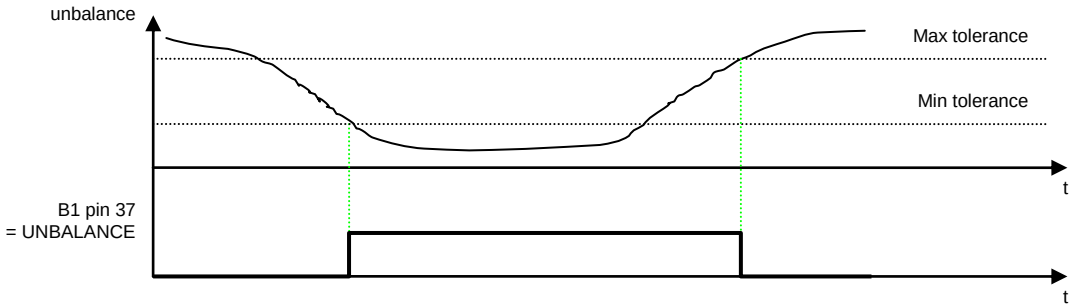
The parameters refer to the control of the balancing operation. They are at the heart of the balancing cycle and the purpose of using them is to optimize the performance in terms of speed and precision.

These parameters are made modifiable to ensure outstanding adjustment flexibility.

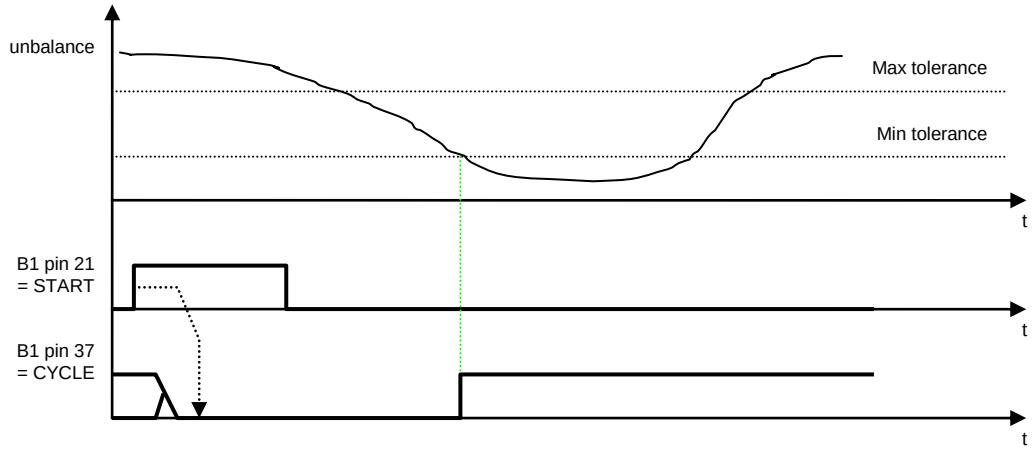
ID	Parameter	Description
	Start balancing mode **[MAX TOL]**	Setting of the signal mode of the Wheel OK output (connector B1 – pin 37 - unbalance within tolerance) **MAX TOL** : The automatic cycle starts out of maximum tolerance. **MIN TOL** : The automatic cycle starts out of minimum tolerance.
	Tolerance signalling **[UNBALANCE]** *(see diagram below)*	Setting of the signal mode of the Wheel OK output (connector B1 – pin 37 - unbalance within tolerance) **CYCLE** : the signal is tied to the balancing request. In particular, the output is enabled following a balancing request only when the minimum set tolerance is reached, and is disabled only if there is a new balancing request and the unbalance is outside the set maximum tolerance **UNBALANCE** : the signal is dynamically linked to the unbalance value. The output is enabled only when the minimum threshold is reached and remains such until the maximum threshold is passed (hysteresis behaviour)
	Manual balancing **(Pre-Balancing)** **[OFF]** *(with manual balancing option)*	Guided manual balancing (pre-balancing) procedure **OFF**: Not enabled **ON**: Enabled
	Power-up balancing **[OFF]**	Defines the system's mode of action when the wheel starts **ON**: The system checks the balancing state of the wheel (once it has reached nominal speed) and carries out the balancing cycle if an unbalance greater than the maximum tolerance threshold is detected. **OFF**: The system waits for a request (manual or through the machine's CNC) before carrying out a balancing cycle.
	Number of cycles counter **[1]**	Some grinding cycle programs envisage that at the end of every piece the CNC sends a balancing cycle start command to the balancing system. The setting of this parameter consists of predetermining every so many machine cycles a balancing cycle is to be run. By setting 1, we get a balancing cycle with every request. By setting 100, the cycle is run every 100 requests. Once the set number of requests is reached, the balancing is done only if the unbalance of the grinder exceeds the maximum set tolerance. It is possible to also set a number of cycles equal to 0. In this case, a system test function is enabled that runs a balancing cycle every time the unbalance exceeds the maximum tolerance threshold if the machine CNC keeps the balancing request active.
	Balancing cycle timeout [s] **[600]**	Time beyond which the automatic balancing cycle is aborted if the system is unable to steadily take the unbalance within the tolerance limits. In this case the BALANCER ALARM output is enabled (connector B1 – pin 12) and if the unbalance is deemed acceptable, also the tolerance output Wheel OK (connector B1 – pin 37) is enabled.

ID	Parameter	Description
	Fine adjustment **[OFF]**	Intended for special applications, it enables an operation mode of the balancing algorithm for reaching very narrow tolerances. The choice of the setting of this parameter (other than OFF) is strictly dependent on the application, and must be performed by Balance Systems service personnel. **OFF**: Standard automatic balancing cycle. **OFF+HS**: balancing cycle with quick learning. **ON**: balancing cycle optimized for narrow tolerances. **ON+HS**: balancing cycle optimised for narrow tolerances and quick learning.
	Machine stiffness **[DEFAULT]**	This makes it possible to shift the work point of the balancing algorithm according to the machine's rigidity, in other words, how the machine responds to the movements of the compensation weights within the balancing head. This ensures that, during installation, the performance of the balancing system can be optimized. **DEFAULT**: Standard settings. **1..9**: The higher the number set, the greater will be the energy that the balancing system uses for reaching the tolerance limits entered. **CUSTOM**: Reserved for special settings that are usually entered by Balance System's service personnel. (see CUSTOM STIFFNESS)

Output B1 pin 37: tolerance signalling = UNBALANCE



Output B1 pin 37: tolerance signalling = CYCLE



1.2.5.1. CUSTOM STIFFNESS

Modification of the following parameters must be supported by Balance Systems personnel.

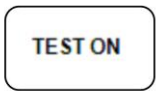
ID	Parameter	Description
	Cross voltage [%] **[60]**	Voltage value adopted to supply power to the motors during the crossing balancing attempts. It is a percentage of the driver voltage.
	Min cross pulse [s] **[0.1]**	Minimum duration of the crossing balancing attempt.
	Max cross pulse [s] **[3.0]**	Maximum duration of the crossing balancing attempt.
	Parallel voltage [%] **[60]**	Voltage value adopted to supply power to the motors during the parallel balancing attempts. It is a percentage of the driver voltage.
	Min parallel pulse [s] **[0.5]**	Minimum duration of the parallel balancing attempt.
	Max parallel pulse [s] **[5.0]**	Maximum duration of the parallel balancing attempt.

1.2.6. ROTATION SPEED CONTROL

ID	Parameter	Description
	Synchronism source **[INTERNAL]**	Indicates the source of the synchronism signal to calculate the rotation speed of the spindle. **INTERNAL**: the sensor is embedded into the collector (connector B4) **###**: Option not selectable. **SOFTWARE**: the sensor is simulated by software. The RPM value is programmed in the parameter “Nominal rotation speed”.
	Synchronism limit for diagnostics [rpm] **[60]**	Threshold used to detect failure of the synchronism sensor
	Min rotation speed [rpm] **[200]**	Minimum operating rotation speed of the spindle.
	Max rotation speed [rpm] **[6000]**	Maximum limit for the spindle rotation speed. Beyond this limit an alarm is signalled that is automatically restored only after having stopped the spindle.
	Nominal rotation speed [rpm] **[500]**	Rotation speed that the spindle has to steadily reach so that the NOMINAL ROTATION SPEED condition is indicated. Based on the settings the installer makes, the automatic balancing commands may not be executed or aborted beneath this limit.
	RMS Filter **[0]**	Low pass filter value which gives a reduction of disturbance on rpm value, eliminating the high frequency components. The higher the value entered, the greater the attenuating effect of the high frequency which is achieved.
	RPM stability check **[OFF]**	Enables the rotation speed steady state check. This parameter is combined with the “nominal rotation speed” to define the steady nominal speed condition. **OFF**: Disabled **ON**: Enabled
	Bar graph **[ON]**	Bar graph representation of the speed and thresholds of rotation. **OFF**: Not enabled **ON**: Enabled

1.2.7. DIAGNOSTIC

ID	Parameter	Description
	Diagnostic data **[OFF]**	In the balancer status area on the screen, some of the physical quantities can be monitored for debug purposes. When this monitoring is enabled it also includes the plot line of the unbalance vector during balancing. In detail: **OFF**: No quantity monitored. **COLLECTOR**: Typical quantities for the collector f [Hz] = coupling frequency Is [mA] = static part current Vs [V] = static part voltage Vr [V] = rotating part voltage Error = error code on communication channel **Cmots**: Typical variables for the motors *Other options (for BS personnel)* **Algorithm** **Head** **ANI-G0** **ANI-G1** **aPos1** **AlgoNoTr** **To-Rx** **ASepNoise** **CMs-A** **Temperature**
	PICK-UP 1 ready check **[OFF]**	Activation of the control of connection of the vibration sensor No.1 [connector B5]. In case that the connection fails, an alarm is issued to the PLC and the error icon  appears on screen in the status area. **OFF**: Disabled **ON**: Enabled

Icon  or  set the system in TEST MODE. It is referred to BN card tester device (Further informations are indicated on 9UMENX524-1200 yymmdd VMTools Signals simulators manual)

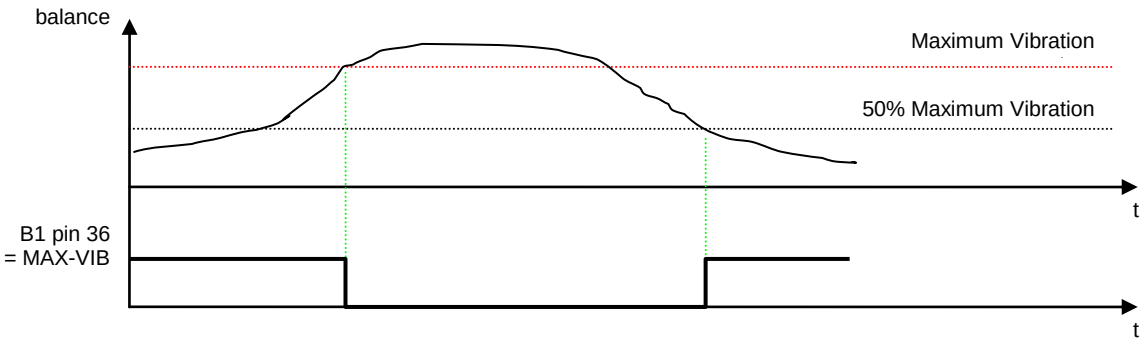
1.3. Work

1.3.1. PART-PROGRAM 1

ID	Parameter	Description
	Label **[NONE]** ***(HMI ONLY)***	Customizable field for labeling the name of the balancing plane (example: “Main bearing”, “Counter bearing”)
	Unbalance filter **[F64]**	Filtering method for the unbalance signal High filtered **F64** = fast reaction **N64** = normal reaction **S64** = slow reaction Filtered **FF32** = very fast reaction **F32** = fast reaction **N32** = normal reaction **S32** = slow reaction Low filtered **N16** = normal reaction Unfiltered **N8** = normal reaction
	Tolerance signaling timeout [s] **[0.5]**	Programmable timer. The value indicates the time between out of tolerance condition and effective I/O signalling. It could be useful, for example, when grinding wheel movements is necessary and the unbalance condition has to be masked to the PLC.
	Maximum vibration timeout **[5,0]**	Timer to issue the alarm signalling due to maximum vibration (see previous parameter)
	Minimum tolerance **[0.100]**	Limit within which the system has to balance the grinder. This limit is characteristic of all grinding operations and of their work cycle. The automatic balancing cycle stops when the unbalance value is steadily lower than the value of the minimum tolerance threshold.
	Maximum tolerance **[0.200]**	Unbalance limit acceptable for obtaining machined pieces that meet the required tolerances. When the unbalance exceeds this limit, the system prepares itself for automatic balancing.
	Maximum vibration **[60]**	Maximum unbalance threshold. Once this threshold is exceeded, the alarm signaling due to maximum vibration being exceed is enabled. Any automatic cycle in progress is cancelled. The signalling is automatically cleared when the unbalance value is reduced below 50% of the set threshold. For this purpose you can continue by moving the compensation masses in manual mode.
	Balancing at nominal speed **[OFF]**	**OFF**: The automatic balancing cycle is executed even if the speed rotation programmed in the “nominal rotation speed” parameter has not been reached. **ON**: The automatic balancing cycle is executed **only** if the speed rotation programmed in the “nominal rotation speed” parameter has been reached.

ID	Parameter	Description
	Tolerance stability check **[0.1s]**	Control of the stability of the unbalance value inside the programmed tolerance. This could be useful in the case of beat effects generated by the mechanical belt coupling between motor and spindle. **AUTO**: The system uses the standard procedure to signalling the tolerance stability. **0.1s**: This parameter indicates the time which the unbalance vector must be inside the minimum tolerance (green area), before stop the procedure. **0.5s**: This parameter indicates the time which the unbalance vector must be inside the minimum tolerance (green area), before stop the procedure. **Filter**: This parameter indicates the time which the unbalance vector must be inside the minimum tolerance (green area), before stop the procedure. The time is related to unbalance filter parameter.

Output B1 pin 36: Maximum Vibration signalling = MAX-VIB



1.3.2. MANUAL BALANCING [PRE-BALANCING] (optional)

ID	Parameter	Description
	Correction algorithm **[DISPLACEMENT]**	Determines the compensation method used to perform balancing. **DISPLACEMENT**: It envisages two equal weights (e.g. inserts) always on the rotating part that are correctly moved during the procedure phases. **ADDITION:** Envisages the possibility to place and remove the weights during the procedure phases. **WEIGHTS**: Balancing using pre-determined weights (defined in a set of parameters or acquired from the system), to be positioned in special holes arranged along the circumference of the rotating part.
	Tolerance **[0.5]**	Unbalance value that must be reached at the end of the procedure.
	Position errors correction **[CALCULATED]**	Determines the calculation method used to establish the entity of the weight positioning correction. Three methods are available: **ESTIMATE, IDEAL, CALCULATED.** There is no one method better than another a priori. The choice must be made by trials, evaluating the result.
	Insufficient capacity check **[ON]**	If the weights available are not enough to ensure that the set tolerance value is reached, a caution message may be displayed. **OFF**: Not enabled **ON:** Enabled
	Nominal rotation speed [n/min] **[500]**	Speed of rotation that must be reached for data acquisition. Below this speed, the system does not allow continuation.
	Rotation direction **[CW]**	Spindle rotation direction from the operator's point of view. **CW:** Clockwise **CCW:** Counterclockwise
	Graduation direction **[CCW]**	Direction of increase of the angles of the graduations defined on the rotating part. **CW:** Clockwise **CCW:** Counterclockwise
	Neutral cycle **[OFF]**	Enables running of the neutral masses cycle for applications requiring management of the automatic balancing using Balance System balancing heads. The running of the cycle allows the initial system unbalance to be minimized and, once the procedure is completed, to guarantee the widest margin of automatic compensation. **OFF:** the cycle is not run **ON:** the cycle is run

1.3.2.1. COMPENSATION WITH MOVING WEIGHTS (DISPLACEMENT)

ID	Parameter	Description
	Weight angular width [0]	Defines the angular sector occupied by each weight in order to be able to enable the compensation capacity controls and to prevent mechanically impossible overlaps.
	Weight angular displacement [90]	Indicates the angle of which the sample weight has to be moved to acquire its effect.

1.3.2.2. COMPENSATION WITH ADDITION OF WEIGHTS (ADDITION)

ID	Parameter	Description
	Weight angular width [0]	Defines the angular sector occupied by each weight in order to be able to enable the compensation capacity controls and to prevent mechanically impossible overlaps.

1.3.2.3. COMPENSATION WITH WEIGHTS FITTED IN HOLES (WEIGHTS)

ID	Parameter	Description
	Number of correction holes [8]	Indicates the number of housings arranged along the circumference for the correction weights. The system requires that the holes be evenly distributed along the circumference.
	First hole angular position [0]	Indicates the angular distance in degrees between the first hole and the zero reference.
	Fine adjustment [OFF]	**OFF** = The correction procedure leads to minimizing the remaining unbalance using the pre-determined set of weights. **ON** = The correction procedure indicates how much one or more weights of the programmed set has to be modified to reset the remaining unbalance.
	Weights type [DEFINED]	**DEFINED** = Recommended in the case the value in grams of each weight of the set is known. In this case the value of the single weight must be set on the “SET OF WEIGHTS” page. **ACQUIRED** = Recommended in the case that the value in grams of the weights to be used is not known beforehand. The system provides information for acquiring the effect of each weight in the set during the procedure.

1.3.2.3.1 SET OF WEIGHTS FOR “Type of weights = DEFINED”

ID	Parameter	Description
	Weight 1 .. 10 **[0,05 0,1 0,2 0,5 1 2 5 10 20 50 ...]**	Value in grams of weight No. 1 ... No. 10

1.3.2.3.2 SET OF WEIGHTS FOR “Type of weights = ACQUIRED

Follow the guided acquisition procedure.

2. Touch Detector [type TD]

2.1. Option

ID	Parameter	Description
	Configuration mode **[BASE]**	Depending on the hardware with which the card is configured and the type of sensor used, the acquisition system can work in 2 different ways with increasing complexity of programming. **BASE** mode **MULTIBAND** mode
	Part Program **[OFF]**	Enabling of Part-Program use **OFF**: Disabled. Part-Program No.1 is the only available. **ON**: Depending on the No. of sections enabled, a number of part-program are available: Section A > 16 Part-Program Sections A+B > 8 Part-Program per section Sections A+B+C+D > 4 Part-Program per section
	Envelope **[SECTION A]**	Enabling of envelope function as follows: **OFF**: Envelope function is not enabled **Section A:** Envelope function is activated on section A only. Function managing is available with I/O, profibus, profinet
	FEA 1 **[2]**	Type of analog module on channel No.1
	FEA 4 **[2]**	Type of analog module on channel No.4
	FPGA version	NNNN *(READ ONLY DATA)*
	FFT: nshift right (1/zoom) **[11]**	Shift data to zoom the FFT diagram. Reduce the number to magnify.

2.1.1. HW CONFIGURATION

ID	Parameter	Description
	FPGA version	NNNN (read only)
	FEA 1 **[0]**	Type of analog module on channel No.1
	FEA 2 **[0]**	Type of analog module on channel No.2
	FEA 3 **[0]**	Type of analog module on channel No.3
	FEA 4 **[0]**	Type of analog module on channel No.4

ID	Parameter	Description
	DEMODULATOR FREQUENCY [MHz] [12.5]	Operating frequency for Multiband and Enhanced mode
	RESET MODE VM20 LIKE	Signal I/O interface compatible with VM20. No “Change part program enable” is necessary. Further details are described on signal interface manual (VM20 (like) - Part-Program change)

2.1.2. CONFIGURATION (BS)

ID	Parameter	Description
	Sections	It Defines No. of Sections, means No. of simultaneous processes, to be controlled. **A**: 1 process
	Envelope **[SECTION A]**	Enabling of envelope function as follows: **OFF**: Envelope function is not enabled **Section A:** Envelope function is activated on section A only. Function managing is available with I/O, profibus, profinet
	Status Format **[IdFmt]**	**Legacy**: Envelope function is not enabled **IdFmt:** Set “IdFmt” parameter in order to use Envelope function on section A

IMPORTANT

The three parameters above must be properly defined in order to prepare the correct data communication.
The possible combinations are defined in the following table.

NOTE: Other combinations of the following parameters are not allowed.

Configuration (BS) parameters			Card operating mode
Sections	**Envelope**	**Status format**	
A	**OFF**	**Legacy** or **IdFmt**	Section A only, without Envelope
A	**Section A**	**IdFmt**	Section A only, with Envelope

2.2. Setup

The setup of the touch detector parameters is based almost on defining the full scale and filters on the reading of the various transducers used. In order to avoid repeating the same concepts, we prefer to write only one detailed description of these parameters that we will then refer to when setting the various transducers (Acoustic Emission, Power, etc.).

Full-scale

The full scale value is the maximum value of the quantity in question that the device can represent. The full scale value must be set in order to display the desired quantity in a suitable scale of values. Let us imagine to have to, for example, set the full scale of power of a motor that when idling absorbs 3 kW, and at full load 9 kW. By setting the maximum possible value, i.e. 300 kW, we notice that the idle – full load change corresponds to 3% of the full scale. This entails a calibration phase of the extremely critical thresholds. By setting a 10 kW full scale, we get a 50% change, and therefore also power changes in the order of tens of Watts will be appreciable.

A second purpose of the full scale is to make the order of quantity of the entities monitored homogeneous. It is advisable that regardless of the type of quantity used for the signals, they be represented by the same percentage level. In this way the CORRECTION function that works to an equal extent on all quantities will have the same weight on all the entities (like a normalization).

As a final advantage, this parameter lets make different machines similar to each other on the set-up level. By correctly adjusting the full scale, it will be possible to set the same values for two completely different machines, thus helping the operator who works on more than one machine.

RMS Filter

This is a digital filter that can smooth the higher frequencies that disturb the reading of the transducers. The band-pass of the filter is programmable using the coefficient that can take on values between 0 and 255. The higher the set value, the lower the filter band pass and the greater the signal stability. The greater the signal stability, the longer the response time.

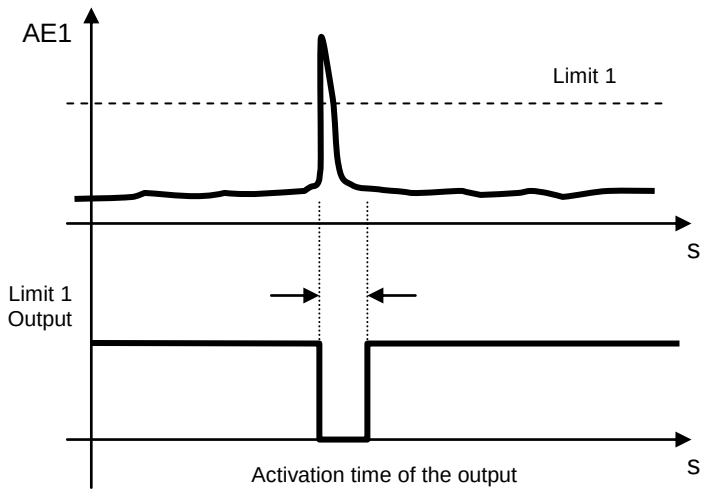
It is advisable to note that in many cases amongst the high frequency components there are the main harmonics for identifying Limits, so setting the filter must maintain correct system operation. In other words, top performance is not necessarily obtained with a “clean” signal. The relationship between filtering coefficient value and band pass is not linear, and about 70% of adjustment is achieved with values from 200 to 255. By setting 255, we get response time higher than 100ms.
Depending on the type of signal, the filter can be calibrated by setting an intermediate value (e.g. 100), checking the performance in terms of response to Limit 1 and gradually correcting the value until the signal is optimized.

Reset

The term “reset” identifies two types of action:

- initialization at the disabled status of the digital outputs regarding the programmed limits (1, 2, 3 and 4)
- updating of the calculated variables

2.2.1. INPUT - OUTPUT

ID	Parameter	Description
	Handshake management **[OFF]**	Mode to implement the digital I/O interface **OFF** = Without signals handshake management **ON** = With signals handshake management For details see: Signals Interface
	Reset mode **[STATUS]**	Mode of managing the RESET inputs of the touch detector card. **EDGE**: The limits are restored as soon as the machine PLC/CNC enables the reset signal. **STATUS**: The limits are restored at the instant when the machine PLC/CNC enables the reset signal. The card remains in reset status for the entire duration of the reset signal. The card does not update the output signals for the entire duration of the restoration status. **ST+TEST**: The limits are restored in the instant when the machine PLC/CNC enables the reset signal and all the outputs (Limit 1, Limit 2 and Limit 3) are activated until the restoration signal is disabled. This mode makes it possible to carry out tests on the machine and card signalling test. ➔ *The card does not update the output signals for the entire duration of reset.*
	Reset at start-up **[OFF]**	Status of the device at start-up. **OFF**: Safety mode. The device starts up and the outputs are activated for safety. The device needs a RESET to be enabled. **ON**: While the device starts up a RESET is performed automatically. The device is enabled and ready to work. **LIMITS**: The device starts up and the outputs are deactivated. The device needs a RESET to be enabled.
	Reset while Manual <> Automatic **[OFF]**	Executes the reset of the output signalling each time there is a shift made between manual and automatic operations. **OFF**: Disables the reset function in the manual / automatic shift. **ON** : Enables the reset function in the manual / automatic shift. ➔ *Selecting ON, moving from automatic to manual or vice versa, all signals acquired of the work in progress will be lost.*
	Min activation time of the outputs [ms] **[0]**	Minimum time for enabling outputs regarding to Limits 1, 2, 3 and 4 when the “NORMAL” signalling mode is programmed 

ID	Parameter	Description
	Remote control **[OFF]**	**OFF:** Disabled. **MN:** Enabling of communication to the Profibus/Profinet interface. Attention: With this setting, all digital inputs of the card are disabled (as they are managed via the Profibus/Profinet protocol) while the outputs continue to work normally. **MN+DI:** Enabling of data communication to the Profibus/Profinet interface. All digital inputs and outputs of the card are enabled.

2.2.1.1. D1 CONNECTOR

ID	Parameter	Description
	Digital interface D1 **[OFF]**	Digital I/O interface connector D1 Depending on which software version is installed: Version earlier than V110.1507xx **OFF** = The D1 connector is not installed on the card **ON** = The D1 connector is installed. Version later than V110.1508xx **OFF** = The D1 connector is not installed on the card **BASE** = The D1 connector, with "BASE" signals only (signals highligthed on yellow color in the document Components, is installed. **FULL** = The D1 connector, with all signals, is installed. For details refer to Components Signals interface

2.2.1.2. D2 CONNECTOR

ID	Parameter	Description
	D2.Pin1 input **[RESET A]**	Signal associated to the digital input on connector D2: **RESET A**: Reset and enabling of section A signalling
	D2.Pin2 input **[AUTOMATIC LOCK]**	Signal associated to the digital input on connector D2: **SELECT**: Select Part Program (1 or 2) and Part Program enable on Section A **AUTOMATIC LOCK**: Set and lock the device in automatic mode **RESET B:** Reset and enabling of section B signaling
	D2.Pin4 output **[L1 A]**	Signal associated to the digital output on connector D2: **L1 A**: Signalling of Section A - Limit 1

ID	Parameter	Description
	D2.Pin5 output **[L2 A]**	Signal associated to the digital output on connector D2: **L2 A:** Signalling of Section A - Limit 2 **L1 B:** Signalling of Section B - Limit 1 **Fault:** General alarm **Echo PP0:** Echo of the part-program selected for Section A **Cyc-A:**
	D2.Pin6 output **[L3 A]**	Signal associated to the digital output on connector D2: **L3 A:** Signalling of Section A - Limit 3 **L1 B:** Signalling of Section B - Limit 1 **L1 C:** Signalling of Section C - Limit 1 **AUTOMATIC:** Device operating in automatic mode **Cyc-A:**
	D2.Pin7 output **[L4 A]**	Signal associated to the digital output on connector D2: **L4 A:** Signalling of Section A - Limit 4 **L2 B:** Signalling of Section B - Limit 2 **L1 D:** Signalling of Section D - Limit 1 **AUTOMATIC:** Device operating in automatic mode **Echo PP0:** Echo of the part-program selected for Section A **Cyc-A:** **RESET A:**

2.2.1.3. OUTPUT LOGIC (access with password)

Changing this parameter requires entering the password "**1 3 4 8 9**"

ID	Parameter	Description
	Digital output logic **[NEGATIVE]**	**NEGATIVE** = Outputs active when the signal is at low level (0 V) **POSITIVE** = Outputs active when the signal is at high level (+24 V)

2.2.2. POWER TRANSDUCER [D4]

Parameters concerning the power transducer (or sensor) controlled by the card.

ID	Parameter	Description
	Power Transducer 1: **Full-scale [kW]** **[5.0]**	Power value in kW to be used as full scale. The power value displayed is expressed in % compared to the full scale.
	Power Transducer 1: **RMS filter** **[0]**	Low pass filter value which gives a reduction of disturbance, eliminating the high frequency components. The higher the value entered, the greater the attenuating effect of the high frequency which is achieved.
	Power Transducer 1..8: **RMS downsample** **[1]**	RMS filter downsample. Higher is the value longer is the time required to update the average value used for delta & incremental mode.

If the Power Transducer fails, the operator will be prompted with a message on screen 

, while the machine will be signaled by the dedicated outputs (Fault, Limit 1, 2, 3 and 4 activated simultaneously)

2.2.3. AE1 INPUT [D8]

Parameters concerning the Acoustic Emission sensors controlled by the card. Every card allows up to 4 sensors simultaneously monitored.

ID	Parameter	Description
	ICP **[OFF]**	Enables the current power supply source for the AE sensor connected to the input
	Sensor ready check **[OFF]**	Enables the sensor ready check. If the AE sensor fails, the operator will be prompted with a message on screen 

, while the machine will be signaled by the dedicated outputs (Fault, Limit 1, 2, 3 and 4 activated simultaneously) |
| | **Sensor ready limit**
[0.2] | Defines the noise limit that has to be present to consider the sensor working properly. The permanence of the signal beneath this limit for about 2 seconds triggers the alarm signal to the operator and machine. Restoration of the correct operating conditions automatically resets the signals. |

2.2.4. AUX / AE4 INPUT [D5]

ID	Parameter	Description
	ICP **[OFF]**	Enables the current power supply source for the AE sensor connected to the input
	Energizing voltage **[0,5]**	It sets the excitation voltage used to supply power to the sensor. The value is normally taken from the characteristics of the sensor used.
	Sensor ready check **[OFF]**	Enables the sensor ready check. If the AE sensor fails, the operator will be prompted with a message on screen  , while the machine will be signaled by the dedicated outputs (Fault, Limit 1, 2, 3 and 4 activated simultaneously)
	Sensor ready limit **[0]**	Defines the noise limit that has to be present to consider the sensor working properly. The permanence of the signal beneath this limit for about 2 seconds triggers the alarm signal to the operator and machine. Restoration of the correct operating conditions automatically resets the signals.

2.2.5. GRAPHICS and DISPLAY

ID	Parameter	Description
	Peak detection interval [ms] **[60]**	Time to update the highest value reached on the diagram
	Shift graph **[ON]**	**OFF**: The diagram is updated with re-draw method (from left to right) **ON**: : The diagram is updated shifting the oldest data to the left

2.2.6. DIAGNOSTIC

Icon 

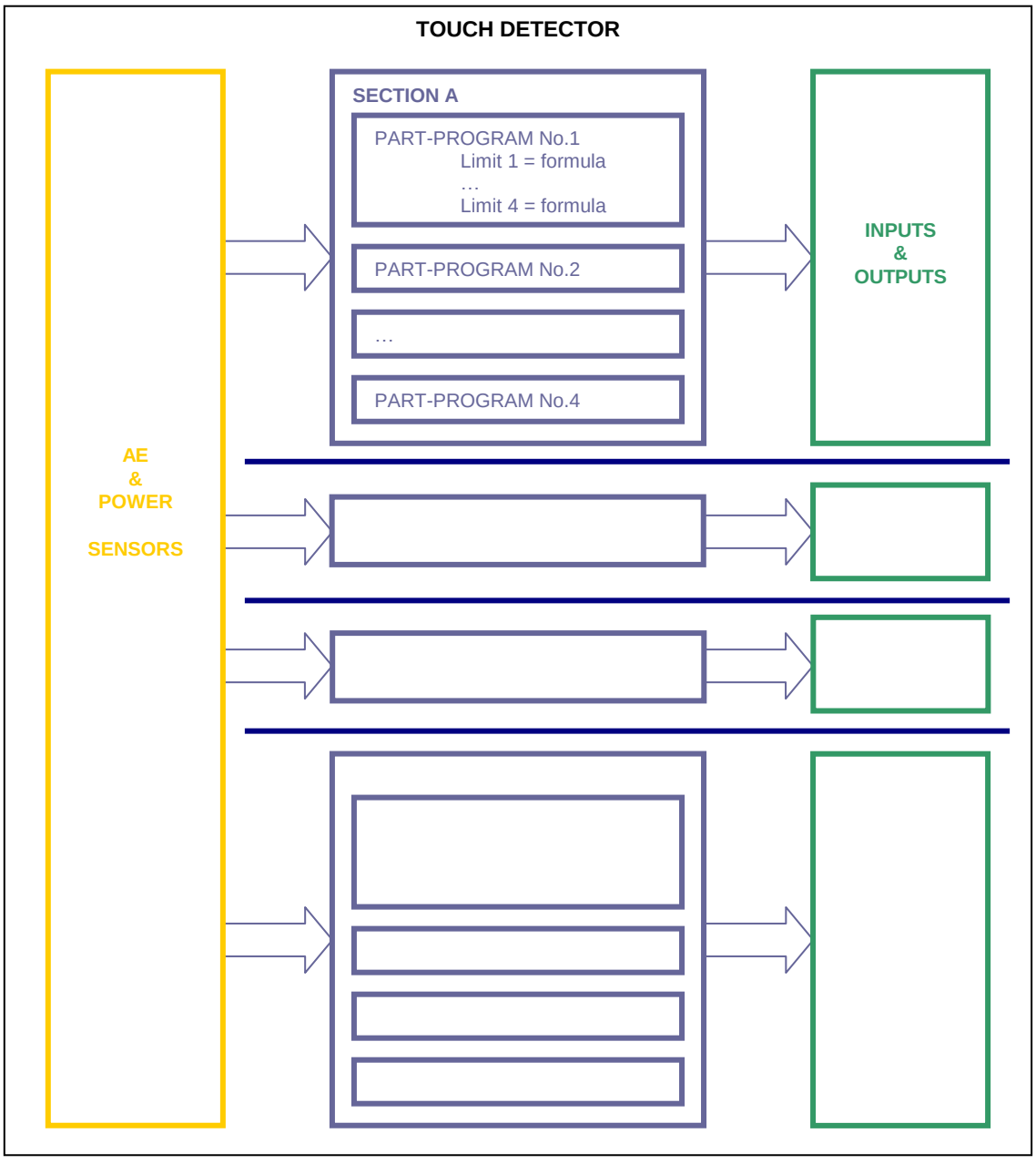
or 

set the system in TEST MODE. It is referred to TD card tester device or AE signal simulator device (Further informations are indicated on 9UMENX524-1200 yymmdd VMTools Signals simulators manual)

2.3. Work

2.3.1. PART-PROGRAM

ORGANIZATION SCHEME OF THE TOUCH DETECTOR



A part-program is defined during installation, depending on the characteristics of the machine and the process.

Up to 4 different **Part-Programs** can be set. They change the management of the **Limit 1, 2, 3 and 4** signals in terms of:

- Vx and Px variables generated by the filtering process, starting from the AE and Power sensors
- Type of processing of the input signals (Absolute, Delta, Incremental)
- Signalling mode of the outputs (Normal, Latch, Edge)
- Value of the thresholds.

All sensor channels are shared by all sections.

Limits 1, 2, 3 and 4 are defined by writing simple formulas.

***NOTE**: Some parameters may not be accessible, depending on the choices the machine manufacturer makes during system installation.*

ID	Parameter	Description
	Part Program # **[1]**	Defines which Part Progam has to be modified: ▪ FORMULA: Output definition ▪ SYNCRONIZATION ▪ GRAPHIC and DISPLAY

2.3.1.1. FORMULA: Outputs definition

Formula structure and glossary:

	Term					Threshold	Operator
Output	**Digital Output signalling**	**Source elaboration**	**Source**	**Channel**	**Comparision**		
Limit 1 = Limit 2 = Limit 3 = Limit 4 =	[N] = No Latch [L] = Latch [E] = Edge	[a] = absolute [i] = incremental [d] = delta	V P	1..4	> <	xxx	+ = logical OR with next term . = end
	Term Protection					**Threshold protection**	

Complete structure of outputs definition:

Output					**Comment**
Limit 1 =	Term 1 > xxx +	Term 2 > xxx +	Term 3 > xxx +	Term 4 > xxx	Up to 4 terms
Limit 2 =	Term 1 > xxx +	Term 2 > xxx +	Term 3 > xxx +	Term 4 > xxx	Up to 4 terms
Limit 3 =	Term 1 > xxx +	Term 2 > xxx			Up to 2 terms
Limit 4 =	Term 1 > xxx +	Term 2 > xxx			Up to 2 terms

Example: The process uses acoustic emission and power sensors simultaneously

Limit 1 = N iV 1 > 30.0 + N iP 1 > 15

Limit 1 is used as GAP ELIMINATION based on incremental value of variable 1 (greater than 30%) OR power channel 1 (greater than 15%). The digital output signal is NORMAL (free running).

Limit 2 = L a-- > 0.0

Limit 2 not used

Limit 3 = L aP 1 > 80.0

Limit 3 is used as ANTI-CRASH detection based on the absolute istantaneous value of the power channel 1 (greater than 80%). The digital output signal is LATCHED until the next reset.

Limit 4 = L a-- > 0.0

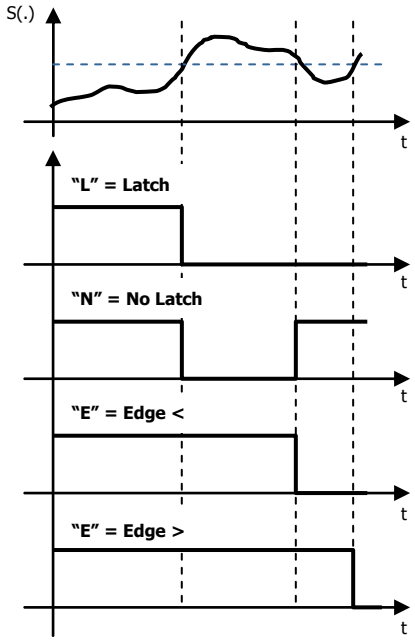
Limit 4 not used

NOTE: Terms or Thresholds which appears in "reverse mode" are protected by the system installer

Example: Limit 1 = N iV 1 > 30.0 + N iP 1 > 15

The term "N iP 1 >" is protected and can be modified by system installer only.

DIGITAL OUTPUT SIGNALLING

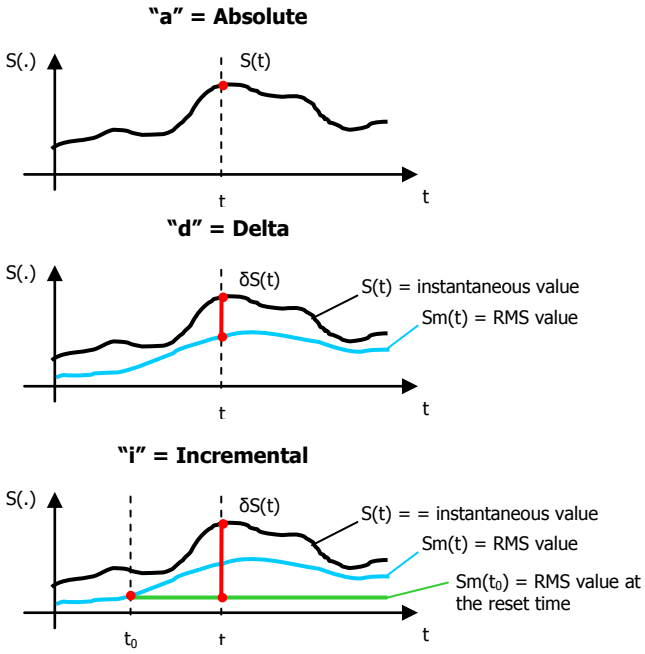


L = Latch, the signal is enabled when the value of the quantity passes the threshold and stays enabled until when a restore is forced (namely, a threshold reset)

N = No Latch, the signal follows the quantity in comparision with the threshold.

E = Edge, the signal is enabled when the value of the quantity passes the threshold; unlike latch mode, the passing over must occur according to the pattern specified by the comparison sign. Specifically, the signal is on the leading edge with the “>” sign, and on the trailing edge with the “<” sign. Once enabled, the signal persists until a restore is forced.

SOURCE ELABORATION



a = absolute, the instantaneous value of the quantity is taken into consideration and compared with the threshold value.

d = delta, is the difference between the actual value S(t) and the RMS value Sm(t) calculated up to that moment. This difference is compared with the set threshold value.

i = incremental, is the difference between the momentary value S(t) and the RMS value Sm(t) calculated up to the moment of the last reset. This difference is compared with the threshold value.

NOTES and EXAMPLES

- *It is worth using the **absolute** value when the operational conditions are easily identified and when the machine is highly stable.*
- *As far as Limit 3 (used as Anti-crash) management is concerned, usually for power, this value precisely identifies the consumption limit which can maintain the machine's safety.*
- *The use of **delta** quantity is recommended for controlling touch-down (Limit 1 and 2), when there are very quick signal variations (distinguishing touch/non-touch)*
- *When controlling touch, where there are very quick signal variations (distinguishing touch/non-touch), the use of the **incremental** quantity is the same as using **delta**. However, should the variations be slower, it is possible that the delta mode is not so reliable. In these cases, **incremental** control is much more certain since the reference value is "frozen" at the moment of resetting.*
- *Using the **incremental** mode is particularly suitable for those applications in which the operational speed of the machine changes through the day. Usually, when the machine is started up, it consumes more power because the lubricants do not immediately reach the conditions (in temperature and pressure) of normal operation levels, therefore requiring greater effort by the machine. With time, the various components of the machine achieve more stability in their operational conditions, and the power consumed diminishes. Using the incremental mode you acquire, at every reset, an adjustment of the threshold to the new value of the monitored quantity.*

SOURCE and CHANNEL

It indicates which physical input quantity is taken into consideration:

"-" = none	The setting of this value is the same as cancelling the term of the formula.
"V" = Variable	The possible selections are V1, V2, V3, V4. Each Vx variable is generated by the association with a source AE input (connectors D8, D7, D6, D5).
"P" = Power	It is possible to set only one power input among the eight available (P1 . .P8) in every formula of each program (connector D4).

The same input may appear several times in the same formula, even if processed in a different way (absolute, delta, incremental).

COMPARISON

Indicates if the comparison of the value reached by the source in a certain instant and the threshold is positive or negative.

">" when the value of the quantity is greater than the threshold, the signal is activated.
"<" when the value of the quantity is lower than the threshold, the signal is activated.

THRESHOLD

The limit value for the signal. This value is always correlated with the way the monitored quantity is used.

OPERATOR

Indicates the link between the terms of each formula. It can assume the two values described below.
"." ends the formula.
"+" indicates the presence of a successive term. When a formula is made up of two or more terms, for signalling purposes they must be considered in logical OR condition. In other words, the signalling will be given the moment that one condition of the formula is true.

FORMULA PROTECTION

The installer can decide to protect access to the parameters making up the Limit 1, Limit 2, Limit 3 and Limit 4 signalling formulas. This feature guarantees the machine manufacturer that improper device programming is prevented.
To get an effective and flexible method of protection, each term of every formula has been divided into two parts, TERM and THRESHOLD, which can be independently protected.

A typical example for applying formula protection is in managing the limit 3 as anti-crash. In this case, the machine manufacturer can set the second term in the limit 3 formula definition and protect it. In this way, any mistake made by the user will not damage the machine or be a cause of danger to the operator.

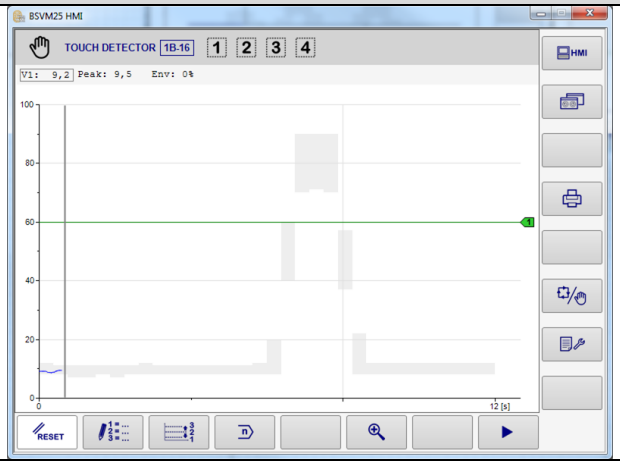
2.3.1.2. ENVELOPE

ID	Parameter	Description
	Envelope **[OFF]**	**ON:** Envelope function is enabled **OFF:** Envelope function is not enabled
	Source **[V1]**	Entity to be used as source of the envelope analysis. The sources may be: **OFF:** Analog output disabled **V1:** Variable V1. **V2, V3, V4:** see above. **PA:** filtered Power value (P1-P8) **PB:** see above.
	No. of Zones **[256]**	It defines the number of zones in which the entire process is divided. Comparison between master cycle and current cycle is performed for each zone during entire process duration. Min value: 16 Max value: 256
	Self learning process duration **[OFF]**	It defines how the process duration is defined: **ON**: process duration is automatically learned by the system using an apposite duration learning cycle. **OFF**: process duration is defined by user with “Process duration” parameter.
	Process duration [s] **[12]**	It is enabled if “Self learning process duration” parameter is set OFF. It is defined by user according with duration of the process to analyse. Min value: 16 s Max value: 6500 s
	Process timeout [s] **[12]**	It defines waiting time before “process timeout” signalling if no more processes (learning or comparison) are in progress and no “stop process” signal has been sent to the system.
	Calculation algorithm master **[AVG]**	It defines the algorithm with which master shape is calculated if more than one master cycle is executed. **AVG**: average of a defined number of executed master cycles is performed (defined by “No. of averages” parameter)
	No. of averages **[1]**	Number of cycles to be executed in teaching mode in order to define the master shape

ID	Parameter	Description
	Autostart **[OFF]**	It defines the source of the start process trigger (learning or comparison): **OFF:** trigger is not enabled, process starts when START signal has been sent to the system. **L1:** trigger is enabled, process starts when L1 threshold has been exceeded. START signal is necessary before L1 activation. **L2:** See above **L3:** See above **L4:** See above **EXT:** trigger is enabled, process starts when EXT signalling has been sent to the system. START signal is necessary before EXT signalling.
	Autostart timeout [s] **[12]**	It defines waiting time before “Autostart timeout” signalling if no trigger occurs after START signalling. It is possible to set only if autostart parameter is different by OFF.
	% for calculation max. curve [%] **[120]**	Master shape percentage which defines upper allowed tolerance level for each zone. Inside each zone, comparison beetwen current cycle shape and master shape is performed. If the average value of the current shape inside related zone is higher then defined percentage of master shape, entire zone assumes ORANGE color. If the average value of the current shape inside related zone is lower then defined percentage of master shape, entire zone assumes DARK GREEN color. ORANGE zone identifies that the process is out of tolerance in that zone. DARK GREEN zone identifies that the process is in-tolerance in that zone. It is related to “Zone over tolerance” signalling.
	Mode max shape limit **[NO LATCH]**	During comparison shapes process, “Zone over tollerance” signal output can be: **No latch:** signal output is reset when each zone starts. **Latch:** signal output is not reset until the process is stopped.
	% for calculation min. curve [%] **[80]**	Master shape percentage which defines lower allowed tolerance level for each zone. Inside each zone, comparison beetwen current cycle shape and master shape is performed. If the average value of the current shape inside related zone is lower then defined percentage of master shape, entire zone assumes YELLOW color. If the average value of the current shape inside related zone is higher then defined percentage of master shape, entire zone assumes LIGHT GREEN color. YELLOW zone identifies that the process is out of tolerance in that zone. LIGHT GREEN zone identifies that the process is in a warning area close to lower allowed tolerance. See “% for calculation near min. curve” parameter, to define how extended warning area has to be It is related to “Zone below tolerance” signalling.
	Mode min shape limit **[NO LATCH]**	During comparison shapes process, “Zone below tollerance” signal output can be: **No latch:** signal output is reset when each zone starts. **Latch:** signal output is not reset until the process is stopped.

ID	Parameter	Description
	% for calculation near min. curve [%] **[80]**	Percentage of difference beetwen upper and lower allowed tollerance which defines how extended warning area has to be. Inside each zone, comparison beetwen current cycle shape and master shape is performed. If the average value of the current shape inside related zone is lower then defined percentage, entire zone assumes LIGHT GREEN color. If the average value of the current shape inside related zone is higher then defined percentage, entire zone assumes DARK GREEN color. LIGHT GREEN zone identifies that the process is in a warning area close to lower allowed tolerance. DARK GREEN zone identifies that the process is in-tolerance in that zone.
	Ignore signal level [%] **[10]**	Evaluated as a fullscale percentage. Tipically these zones represent time intervals where there is no contact. These zones are not considered (ignored) in the overall evaluation of the process.
	IP max limit [%] **[200]**	Master shape percentage which defines instantaneous signal upper allowed level for each zone. '0' = Not used. It is related to "IP over max" signalling (*Profibus or profinet only*)
	Instantaneous max limit mode **[NO LATCH]**	During comparison shapes process, "IP over max" signal output can be: **No latch:** signal output is reset when each zone starts. **Latch:** signal output is not reset until the process is stopped. *Profibus or profinet only*
	IP min limit [%] **[200]**	Master shape percentage which defines instantaneous signal lower allowed level for each zone. '0' = Not used. It is related to "IP below min" signalling (*Profibus or profinet only*)
	Instantaneous min limit mode **[NO LATCH]**	During comparison shapes process, "IP below min" signal output can be: **No latch:** signal output is reset when each zone starts. **Latch:** signal output is not reset until the process is stopped. *Profibus or profinet only*
	IP crash limit [%] **[200]**	Master shape percentage which defines instantaneous signal crash allowed level for each zone. '0' = Not used. It is related to "IP crash" signalling
	Instantaneous crash limit mode **[NO LATCH]**	During comparison shapes process, "IP crash" signal output can be: **No latch:** signal output is reset when each zone starts. **Latch:** signal output is not reset until the process is stopped.

ID	Parameter	Description
	% zone overlapping [%] **[50]**	Overlapping percentage between adjacent zones. Useful if signal variation is too fast (see picture below)

Master shape tollerances with % zone overlapping = 0%	Master shape tollerances with % zone overlapping = 50%
	

2.3.1.3. SYNCHRONIZATIONS

Following a Limit 1, Limit 2, Limit 3 and Limit 4 signalling, it is possible to restore the system and inhibit subsequent signalling for a programmable time. This allows masking of the compensating transients or unstable background noise of the source monitored, which have been brought about, for example, by the movement of the axes or variations in the spindle rotation speed.

ID	Parameter	Description
	Reset delay [s] **[0.0]**	Time which must elapse after a reset of Limit 1, 2, 3, and 4 signals so that the device becomes ready for a new signalling.
	L1: Activation delay [ms] **[0]**	Time which must be TRUE a comparision condition in a formula to activate the correspondent output (Limit 1)
	L2: Activation delay [ms] **[0]**	Time which must be TRUE a comparision condition in a formula to activate the correspondent output (Limit 2)
	L3: Activation delay [ms] **[0]**	Time which must be TRUE a comparision condition in a formula to activate the correspondent output (Limit 3)

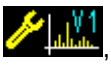
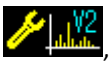
2.3.1.4. GRAPHICS and DISPLAY

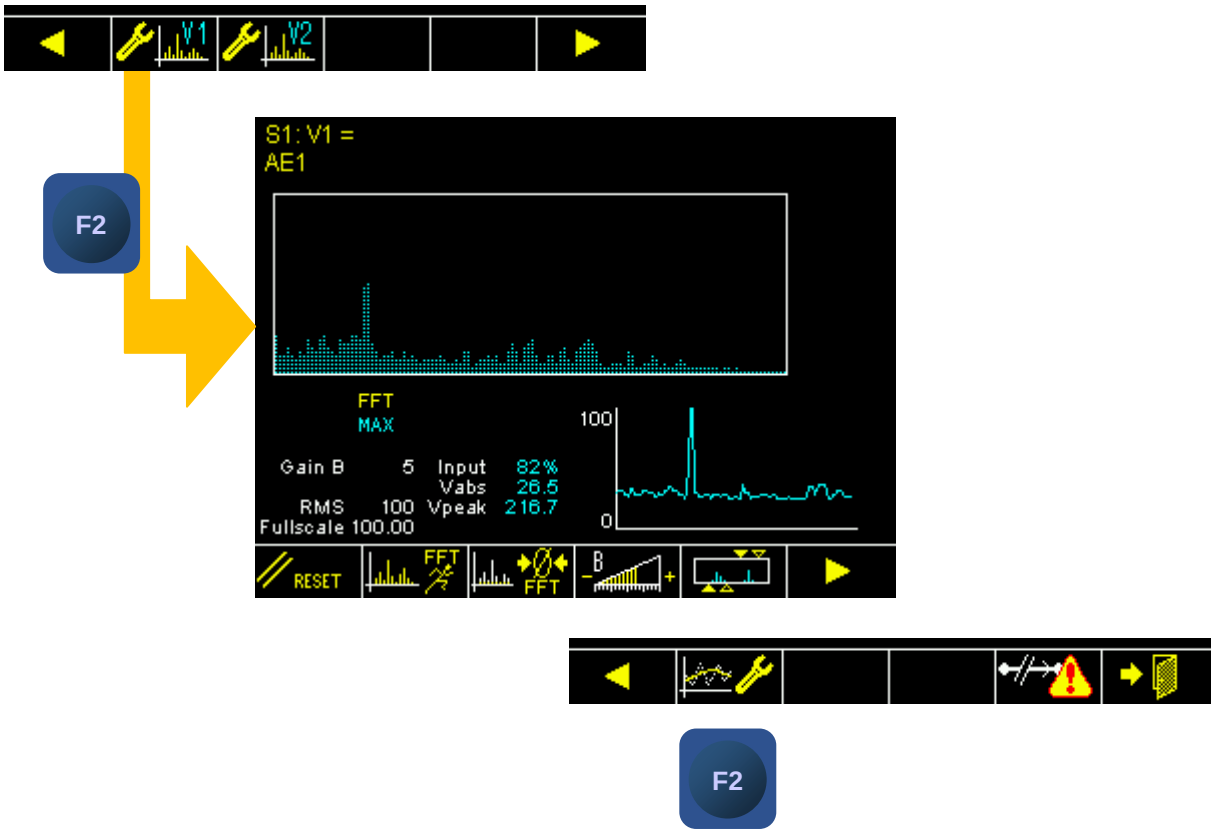
ID	Parameter	Description
	Label **[NONE]** ***(HMI ONLY)***	Customizable field for labeling the name of the process.
	Diagram time window [s] **[40]**	Indicates the duration of the window graph represented.
	Trigger position **[6]**	Indicates the time delay between the event causing the Limit 1, 2, 3 or 4 signal and the real diagram freezing; this parameter is helpful so as to be able to analyze the transient causing the signalling. It is advisable to set the freezing point close to the centre of the diagram. This parameter is significant only if one of the "freeze graphic on Limit …" parameters has been set.
	Freeze diagram on Limit 1 **[OFF]**	Following a Limit 1 signal, the diagrams of the monitored quantities are frozen with the delay defined by the "Trigger position" parameter (see above). In this way it is possible to completely analyze the event **OFF**: The graph is not frozen **ON**: The graph becomes frozen. The graph resumes its updating with the next reset.
	Freeze diagram on Limit 2 **[OFF]**	See above
	Freeze diagram on Limit 3 **[OFF]**	See above

2.3.1.4.1 V1, V2, and POWER DIAGRAM

ID	Parameter	Description
	Diagram display mode **[ABSOLUTE]**	**ABSOLUTE**: The diagram represents the quantity in absolute mode. **INCREMENTAL**: The diagram represents the quantity in incremental maintaining congruency with the thresholds represented. *NOTE: At least one term programmed as INCREMENTAL must be written in the formula.* **LOGARITHMIC**: Diagram is shown with logarithmic scale
	Diagram: Max value **[100]**	Maximum value on the diagram.
	Diagram: Min value **[0]**	Minimum value on the diagram.

2.3.2. V1, V2, V3, V4 VARIABLE SETUP

The following parameters menu is available under the commands  ,  , example:



ID	Parameter	Description
	Source **[AE1]**	Bind the Vx variable to the signal source (AEx sensor)
	RMS filter **[100]**	Low pass filter value which gives a reduction of disturbance, eliminating the high frequency components. The higher the value entered, the greater the attenuating effect of the high frequency which is achieved.
	Full-scale **[100]**	Value of the signal associated to 100%. The fullscale can be used to normalize the input signals.
	Analog filter by-pass **[OFF]**	**OFF**: The analog filter is enabled. The system displays the entire available frequency band divided into 20 windows of observation. **ON**: The analog filter is disabled. The system displays the entire available frequency band.
	RMS downsample **[1]**	RMS filter downsample. Higher is the value longer is the time required to update the average value used for delta & incremental mode.

3. Gauge [type GA and NG]

3.1. Option

ID	Parameter	Description
	Part-Program **[OFF]**	Enabling of Part-Programs use

3.2. Setup

3.2.1. INPUT - OUTPUT

ID	Parameter	Description
	Reset mode **[ENABLE]**	Defines the functioning of the gauging unit with regard to the reset signal. **START**: The reset signal is active on the rising edge and determines the reset of the outputs (commands), after the time defined in the program parameter "START CYCLE DELAY". The return to zero of the reset signal does not imply any change of the outputs status. **ENABLE**: The reset signal functions on state. When the reset is activated, the outputs are enabled after the time defined in "START CYCLE DELAY, and they are activated with regard to the trend of the dimension. When the reset signal is disabled, the outputs are inhibited and they appear as not active.
	Post-Process 7 bands control **[OFF]**	**ON:** Enable classification made in 7 bands **OFF:** Disable classification made in 7 bands restoring classification in 5 bands
	Dimension format **[BCD]**	**BCD:** Binary Coded Decimal format. **ABS+SIGN:** Binary code with representation of absolute value + sign bit. **CPL2:** Binary code in two's complement.
	Remote control **[OFF]**	**OFF:** Disabled. **MN:** Enabling of communication to the Profibus/Profinet interface. Attention: With this setting, all digital inputs of the card are disabled (as they are managed via the Profibus/Profinet protocol) while the outputs continue to work normally. **AO:** Enabling the analog output on additional card(s). For each NG gauge card, it is possible to use up to 2 analog interface cards (one ore two channels) Note: analog output on G7 connector on NG card and Profibus/Profinet interface can be used at the same time. Analog output on additional card(s) can not be used with Profibus/Profinet interface at the same time.
	Analog output # **[OFF]**	**OFF:** Disabled. **G7:** Parameters listed in the "Analog output" folder are referred to analog output available on G7 connector on NG card. **E1.A01:** Parameters listed in the "Analog output" folder are referred to analog output available on A01 connector on EXTENSION ANALOG ADDITIONAL CARD 1. **E1.A02:** Parameters listed in the "Analog output" folder are referred to analog output available on A02 connector on EXTENSION ANALOG ADDITIONAL CARD 1. **E2.A01:** Parameters listed in the "Analog output" folder are referred to analog output available on A01 connector on EXTENSION ANALOG ADDITIONAL CARD 2. **E2.A02:** Parameters listed in the "Analog output" folder are referred to analog output available on A02 connector on EXTENSION ANALOG ADDITIONAL CARD 2. Note: In order to assign the address (1 or 2) to the additional cards please see "Components guide" on section 4.1.

Icon	ID	Command Name	Button	Description
		Factory preset	F1	Reset at factory preset
		Digital interface test	F2	Digital interface test
		Parameters list display	F7	Enables parameters list view

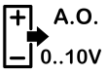
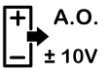
3.2.1.1. OUTPUT LOGIC (access with password)

Changing this parameter requires entering the password "**1 3 4 8 9**".

ID	Parameter	Description
	Digital output logic **[NEGATIVE]**	**NEGATIVE** = Outputs active when the signal is at low level (0 V) **POSITIVE** = Outputs active when the signal is at high level (+24 V)

3.2.1.2. ANALOG OUTPUT (related to Analog output # parameter)

ID	Parameter	Description
	A.O.: Source	Entity to be used as source of the analog output signal. The output signal is a voltage in a specific range (see below), proportional to the quantity of the source. The sources may be: **Dimension A:** Section A dimension **Dimension B:** Section B dimension **G2:** gauge head input G2 **G3:** gauge head input G3 **G4:** gauge head input G4
	A.O: Max Limit **[10V]**	Maximum voltage of the analog output. Values between 0 and 10V
	A.O: Min Limit **[0]**	Minimum voltage of the analog output. Values between -10V and 10V
	A.O.: Zero **[V]** **[2]**	Voltage level related to dimension "0"
	A.O.: Sensitivity **[mV/µm]** **[10]**	Sensitivity of the analog output

Icon	ID	Command Name	Button	Description
		Factory preset	F1	Reset at factory preset
		0..10V analog output calibration	F2	Analog output offset calibration
		-10..10V analog output calibration	F3	Analog output offset calibration
		Parameters list display	F7	Enables parameters list view

3.2.2. TRANSDUCER [G2], [G3], [G4]

ID	Parameter	Description
	Transducer type **[TG200-LG]**	Identifies the transducer employed for the gauging **CUSTOM**: generic transducer. **TG**: standard range Balance Systems gauging transducer: Top Gauge 50, 100, 200, etc. **TG200-LG**: wide range Balance Systems gauging transducer: Top Gauge 200 *NOTE:* see  ***TG200-LG Gauge head acknowledgement*** below.
	Energizing voltage **[5.0]**	The peak value of the supply voltage of the four gauge transducers. Balance Systems' transducers have an excitation voltage set at 5V.
	Transducer sensitivity [mV/mm/V] **[-100.0]**	Sensitivity of the transducer expressed as *mV/mm/V* The sensitivity depends on the type of transducer used and on the mechanical construction of the gauging head. Its value is calculated for using the gauging head with its standard fingers and is automatically recognized by the system or shown on the technical sheet supplied with the gauging head.
	Gauging RMS filter **[398]**	The value of the low-pass filter for reducing disturbance, eliminating the high frequency components. The greater the value entered, the greater the reducing effect of the high frequencies which is achieved. Since the aim of the gauging system gives more emphasis to precision than to speed, the filter is normally set at the maximum value.
	Roundness RMS filter **[370]**	The value of the low-pass filter for reducing disturbance, eliminating the high frequency components. The greater the value entered, the greater the reducing effect of the high frequencies. The value of this filter should be set to achieve the best compromise between the adverse effect of the noise and the shape that is to be evaluated. Setting too high a value, the shape of roundness diagram will tend to not follow the profile of the work piece
	Minimum dimension **[-2.600]**	The amount of maximum negative displacement from zero of the transducers, indicating the minimum value measurable. This value is automatically recognized by the system or is shown on the technical sheet supplied with the gauging head (*PRESTROKE*).
	Maximum dimension **[2.600]**	The amount of maximum positive displacement from zero of the transducers, indicating the maximum value measurable. This value is automatically recognized by the system or is shown on the technical sheet supplied with the gauging head (*OVERSTROKE*).

ID	Parameter	Description
	Upper overrange **[2.500]**	Defines the upper limit of the zero setting in the linear range of the gauging transducer. A zero setting out of this range triggers a signalling to the operator and to the PLC.
	Lower overrange **[-2.500]**	Defines the lower limit of the zero setting in the linear range of the gauging transducer. A zero setting out of this range triggers a signalling to the operator and to the PLC.
	Retraction dimension [mm] **[2.600]**	Amount of positive displacement from zero of the transducers, indicating that the gauge retraction has been performed correctly.
	Retraction control **[OFF]**	Activation of the correctly performed gauge retraction. In case the PLC/NCU recoil command was present, but the transducer has not reached its limit switch, the performed retraction control signal is not activated and the alarm output is activated. **OFF** = disabled **ON** = enabled

TG200-LG Gauge head acknowledgement

With this command the system executes the acknowledgement of the connected transducer and its parameters. Every time that a gauging head, TG200-LG type, is connected with the system already on, it is necessary to execute the command for it to be acknowledged. In case, after the command, the corresponding configuration parameters are not displayed on the screen (as above described), it means the gauge head is not correctly connected or is faulty.

3.2.3. SYNCHRONISM CHANNELS [G6 on GA card or G8 on NG card]

SYNCHRONISM 1

	Parameter	Description
	No. of references per revolution **[1]**	Defines the number of synchronism impulses for each turn of the workpiece holder. The number of impulses is equal to the number of references (or indexes) equally distributed around the circumference of the rotating part. **Important**: *Setting the value "0" the system will generate an internal syncrhonism signal as indicated in the parameter "Minimum part rpm"*
	Minimum part rpm **[10]**	Defines the minimum r.p.m. of the workpiece holder. This is used for checking that the synchronism sensor is operating correctly. **Important**: *In the case of synchronized gauging, if the rpm of the workpiece holder is less than the minimum speed set, the four thresholds for the section concerned will be activated.*

3.2.4. GRAPHICS & DISPLAY

ID	Parameter	Description
	Measuring unit **[mm]**	Specifies the unit of measurement used to express the dimension. **mm** = millimeter [mm] / micron [µm] **inch** = inch / mil
	Number of decimal digits **[0]**	Indicates how many decimals are used when visualizing the dimension. The parameter is connected to the type of measurement unit selected according to the table herebelow.
	Displayed transducers **[FORMULAS]**	**ALL**: all the transducers values are displayed **FORMULAS**: only the transducers used in the formula of the actual part-program are displayed.

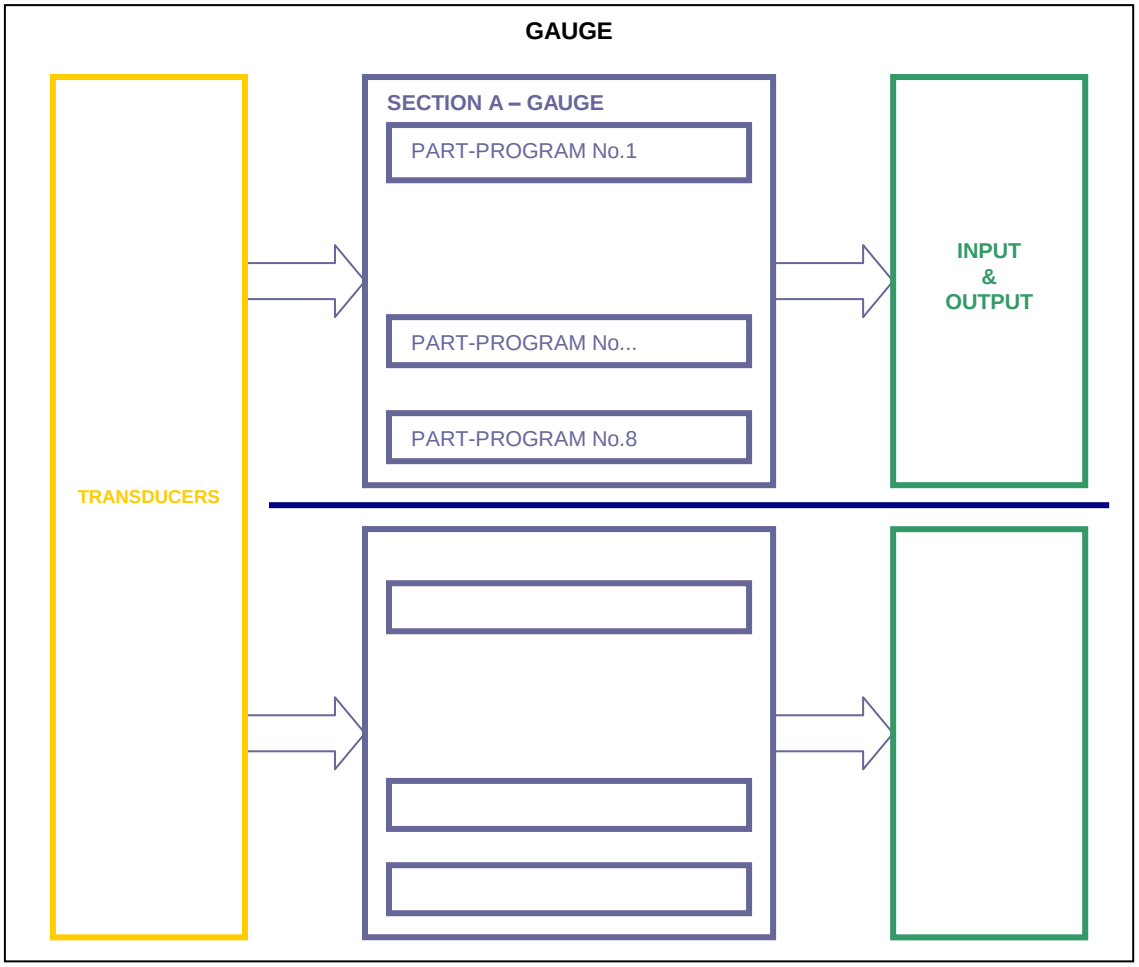
Unit	Number of decimals	Representation		
mm, µm	0	0.123 [mm]	123	[µm]
	1	0.1234 [mm]	123.4	[µm]
Inch, mil	1	0.1234 [inches]	123.4	[mil]
	2	0.12345 [inches]	123.45	[mil]

3.2.4.1. SECTION A

ID	Parameter	Description
	Freeze last dimension **[OFF]**	**OFF:** disabled **ON:** Enables freezing of the visualisation of the minimum quote reached after the activation of the signalling of limit 0. The data is maintained until the next working cycle.
	Needle graph **[OFF]**	**OFF:** disabled **ON:** a needle diagram is shown in order to represent the actual part size
	Dimension diagram: Full-scale **[AUTO]**	Determines the measuring range (Y-axis) represented on the diagram. **AUTO**: The diagram is automatically rescaled (Y-axis) according to the dimension value **1..4**: the diagram has dimensions (Y-axis) specified by the limits 1 (max) and 4 (min) **2..4**: the diagram has dimensions (Y-axis) specified by the limits 2 (max) and 4 (min) **3..4**: the diagram has dimensions (Y-axis) specified by the limits 3 (max) and 4 (min)
	Dimension diagram: Time window [s] **[40]**	Specifies the dimension of the X-axis (time) in seconds. For example, by setting 12, the visualization of the dimension in a time window of 12 seconds is obtained.
	Dimension diagram: Trigger **[OFF]**	Allows for the visualization of the dimension graph to be frozen on a specified event. The normal visualization returns once the selected event is reset. **OFF:** the graph will never be frozen, allowing for the continuous visualization of the dimension **A:** the graph will be frozen when limit A is crossed after time indicated from trigger position parameter **1:** the graph will be frozen when limit 1 is crossed after time indicated from trigger position parameter **2:** the graph will be frozen when limit 2 is crossed after time indicated from trigger position parameter **3:** the graph will be frozen when limit 3 is crossed after time indicated from trigger position parameter **4:** the graph will be frozen when limit 4 is crossed after time indicated from trigger position parameter
	Dimension diagram: Trigger position [s] **[30]**	Associated to the previous parameter, it determines the position in which the visualization of the dimension will be stopped. The parameter is expressed in seconds and in order to determine the position it must be compared with the parameter that expresses the window time range. For example with: Time window = 30 (sec.) Trigger position = 15 (sec.) the graph will stop with the event in the center position.

3.3. Work

ORGANIZATION SCHEME OF THE GAUGE



A part-program is defined during installation, depending on the characteristics of the machine and the process.

Up to 8 different **Part-Programs** can be set defined. They change the management of the **Commands 0, 1, 2, 3, 4** signals in terms of:

- Input Signals (Transducers G2, G3, G4 – gauge head) and their relative channels
- Type of processing of the input signals (Pre / In / Post Process gauge, roundness & shape analysis, etc.)
- Signalling mode of the outputs
- Value of the limits and thresholds.

All transducers channels are shared by all sections.

The transducers G2, G3, G4 are combined by writing simple formulas in order to obtain the dimension to be controlled.

***NOTE**: Some parameters may not be accessible, depending on the choices the machine manufacturer makes during system installation.*

3.3.1. PART-PROGRAM

ID	Parameter	Description
	Offset increment step **[0.0010]**	Indicates the increment / decrement value to be attributed to buttons during the correction of the dimension offset.

3.3.2. PART-PROGRAM for IN-PROCESS GAUGING

3.3.2.1. PART-PROGRAM 1 (up to 8)

How to prepare the part-program for smooth or interrupted surface.

Offset increment step
- **PART PROGRAM**
  - Operating mode — IN-PROCESS
  - Roundness analysis — OFF
  - Gauging cycle start delay
  - **MEASURE**
    - **FORMULA**
      - D = Kq (K2 G2 + .. + K5 G5)
    - Synchronism — OFF , 1, SOFTWARE, G2, G3, G4, DIMENSION
    - **SYNCHRONIZATION**
      - Workhead RPM
      - Mechanical delay
      - Electrical delay
      - Sampling sector
      - Blanking time
      - Gauge mode
      - Workpiece profile
      - Damping
      - Synchronized zero
    - Master deviation from zero
    - Dwell timeout (sparkout)
    - Remaining traverse time
    - **COMMANDS**
      - Limits type
      - Limit 4, 3, 2, 1
      - Limit 0
      - Limit A
  - **GRAPHICS & DISPLAY** (NG only – HMI only)
    - Show transducer graph
    - Show debug
    - Show quote graph
    - Label

ID	Parameter	Description
	Operating mode **[IN-PROCESS]**	**IN-PROCESS**: Check on dimension while the piece is being machined. **POST-PROCESS**: Check on dimension after the piece has been machined. **PRE-PROCESS**: Check on dimension before the piece has been machined.
	Roundness analysis **[OFF]**	**OFF**: Disabled. **ON**: In the in-process gauging, makes a roundness analysis on the work-piece during the dwell (spark-out) period
	Gauging cycle start delay [s] **[0]**	Timer which delays the start of the measuring process, permitting the gauging heads to carry out the mechanical movement of approaching and resting stably on the workpiece.

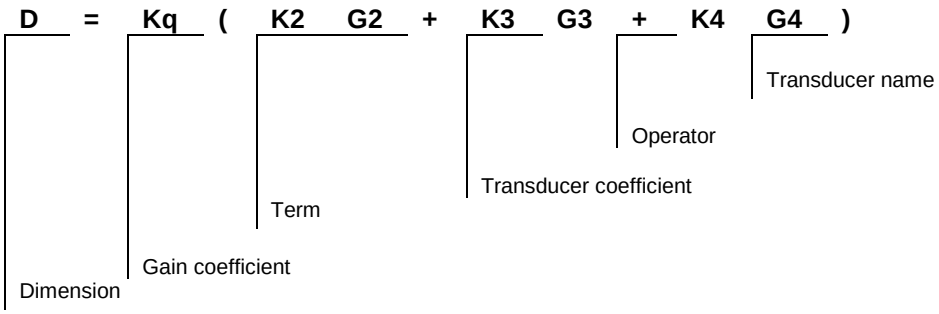
3.3.2.1.1 MEASURE

	Parameter	Description
	Synchronism **[OFF]**	**OFF:** Conventional gauging with continuous checking of the dimension. **1:** Synchronised gauging via the signal taken from the input dedicated to synchronism channel 1 on connector G8 (G6 on GA card). **SOFTWARE:** The sync signal is generated by software. A workpiece rpm is defined by a parameter **G2:** The sync signal is obtained comparing the measure of the gauge head G2 with a threshold **G3:** see above **G4:** see above **DIMENSION:** The sync signal is obtained comparing the dimension with a threshold
	Master deviation from zero [mm] **[0.0000]**	Indicates the deviation of the MASTER piece from quote zero. This permits production of pieces with small differences against the master piece. E.g. if one wishes to produce a circular piece with a plus tolerance of 0.020 mm, this parameter has to be imposed at -0.020.
	Dwell timeout (spark-out) [s] **[-0.1]**	Programmable timer, to force the signalling of limit 0, and which defines the end of the dwell stage (spark-out). This timer is activated at the moment of signalling limit 1 and cuts in, if the quote does not reach limit 0 within the preset time. The value “-1” disables the timer.
	Remaining traverse time [s] **[0.0]**	Necessary time for the grinding machine to carry out a complete passing on the whole longitudinal surface of the piece. This timer is counted from the moment the quote reaches limit 0 while the related command is kept frozen. At the end, the timer determines the activation of the signalling of limit 0.

3.3.2.1.1.1 Formula

The quote is defined by means of imposing a formula, with which the readings of the four transducers (G2, G3, G4) are combined.

The formula is made up of a maximum of 3 ‘‘terms’’. Each term represents the contribution to the gauging of each transducer. The terms of the formula are united by ‘‘operators’’. Each term is made up of two elements: ‘‘transducer coefficient: Kx’’ and ‘‘name of the transducer: Gx’’. Lastly, the overall effect of the terms is multiplied by a ‘‘gain coefficient: Kq’’.
The figure below shows the names used for describing the formula and is followed by a description of each element.



Transducer name

The four controllable transducers have the following names associated to the card inputs:

G2 = transducer for input G2.
G3 = transducer for input G3.
G4 = transducer for input G4.

Transducer coefficient (fine adjustment)

The role of the coefficient K2..K5 is that of carrying out a weighting correction of the reading done by the transducers. The value of such coefficients depends on the sensitivity and the mechanical construction of the transducer.
Normally the value of these coefficients is imposed at 1.0. But should it be necessary to correct them, it is possible to determine them with the following procedure:

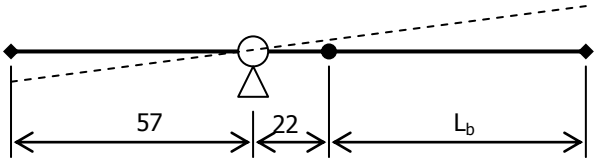
- Execute a zero on a reference surface position
- Insert a master piece with a known thickness, i.e. 0.2 mm, in between the tip and the reference surface;
- Read the displayed dimension, i.e. 0.22 mm
- Calculate the Kx coefficient (related to the current transducer: G2..G4) = Master dimension / Red dimension = 0.2 / 0.22 = 0.9091;
- Repeat this procedure for each transducer used

Operator

Identifies the type of link between the various transducers:
‘‘+’’ = The reading of the transducer that follows is added
‘‘-’’ = The reading of the transducer that follows is subtracted
‘‘)’’ = Terminates the formula.

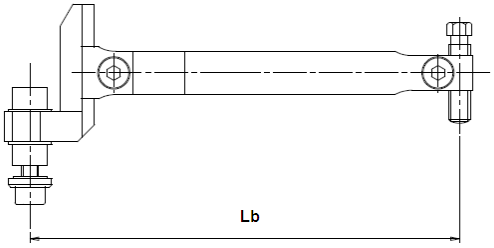
Gain coefficient (finger ratio)

Because the mobile mechanisms of the head carry out circular movements, the coefficient Kq determines an equalisation of the quote based on the finger ratio, i.e. the ratio between the distance gauging tip-fulcrum of the head and transducer-fulcrum of the head (see the following picture).



Kq = (Lb + 22) / 57 for gauging head type Top Gauge 200

where Lb is the finger length.



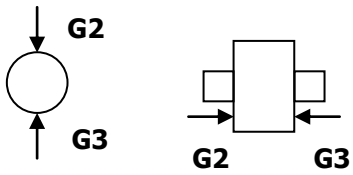
In the following table are displayed the gain coefficient for the standard finger set

Finger ratio	
Finger length Lb [mm]	**Kq for Top Gauge 200**
56	1.368
70	1.614
100	2.140
120	2.491

Alternatively to determine the Kq coefficient it is possible to apply the same procedure described for the transducer coefficients K2..K4.

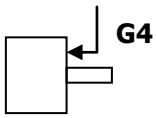
The following situations shown some typical examples of the use of the respective formulas:

Example 1 – Diameter or Thickness gauging using the transducer G2 and G3 and 70 mm finger length (Lb)



Formula: D = 1.614 (1.0 G2 + 1.0 G3)

Example 2 – Position gauging using the transducer G4 and 56 mm finger length (Lb)



Formula: D = 1.368 (1.0 G4)

3.3.2.1.1.2 SYNCHRONIZATION

The following parameters will appear in case of “Synchronism” not equal OFF. The unit of some parameter are defined depending on the type of synchronization.

	Parameter	Description
	Workpiece RPM **[0]**	It indicates the nominal value of the workpiece rotation speed to calculate the time base
	Mechanical delay **[0.0]**	It defines any delay (expressed as an angle) of settling in the mechanical parts of the gauging head, due to the presence of longitudinal discontinuities on the piece. It is calculated starting from the synchronism pulse.
	Electrical delay **[0.0]**	It defines any delay (expressed as an angle) of settling in the electronic conveyor for filtering the gauging. It is calculated starting from when the nominal mechanical delay ends (see above).
	Sampling sector **[360.0]**	It defines the length of the part of the piece (expressed as an angle) where gauging the dimension is to be carried out. The measurement is acquired starting from when any programmed delays end, as previously described.
	Blanking time **[0.0]**	It defines the area of the workpiece where you want to suspend the measure. The suspension begins at the expiration of the sampling sector.
	Gauge mode **[CONTINUE]**	Specifies which type of gauging is to be carried out inside the angle defined by the parameter SAMPLING SECTOR: **CONTINUE:** The dimension is updated in real time. **MAX:** The maximum dimension value is acquired on the sector of the gauging; **MIN:** The minimum dimension value is acquired on the sector of the gauging; **AVG:** The mean dimension value is acquired on the sector of the gauging.
	Workpiece profile **[PLAIN]**	It indicates the type of the surface profile to be measured **PLAIN**: Smooth continuous profile **EVEN**: Interrupted with symmetric profile **ODD**: Interrupted with asymmetric profile
	Damping **[0]**	**0 .. 5**: Filter with damping effect on the measurement. The higher the value, the greater the damping effect.
	Synchronized zero **[OFF]**	**OFF:** The zeroing procedure is made with the master piece in static condition. **ON:** The zeroing procedure is made with the master piece in dynamic condition (i.e. in rotation as the work piece).

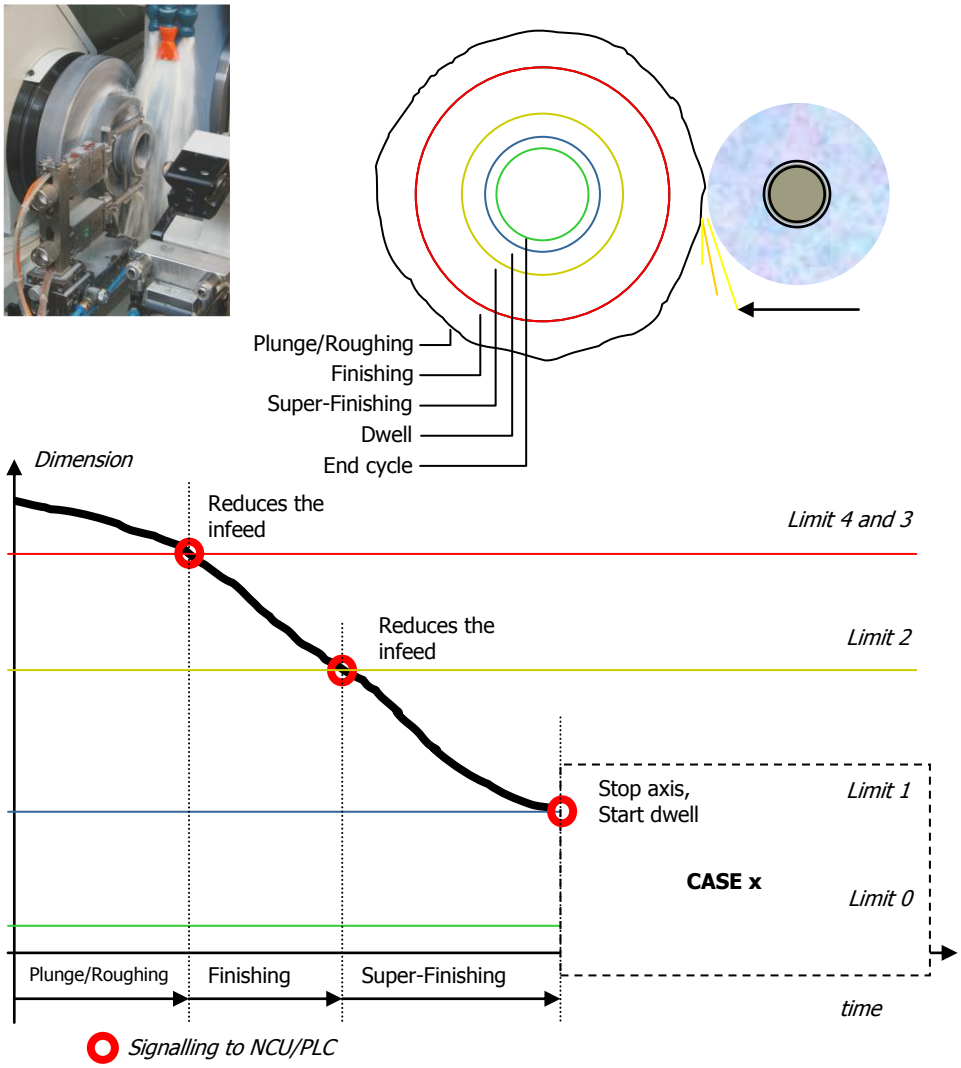
3.3.2.1.1.3 Commands

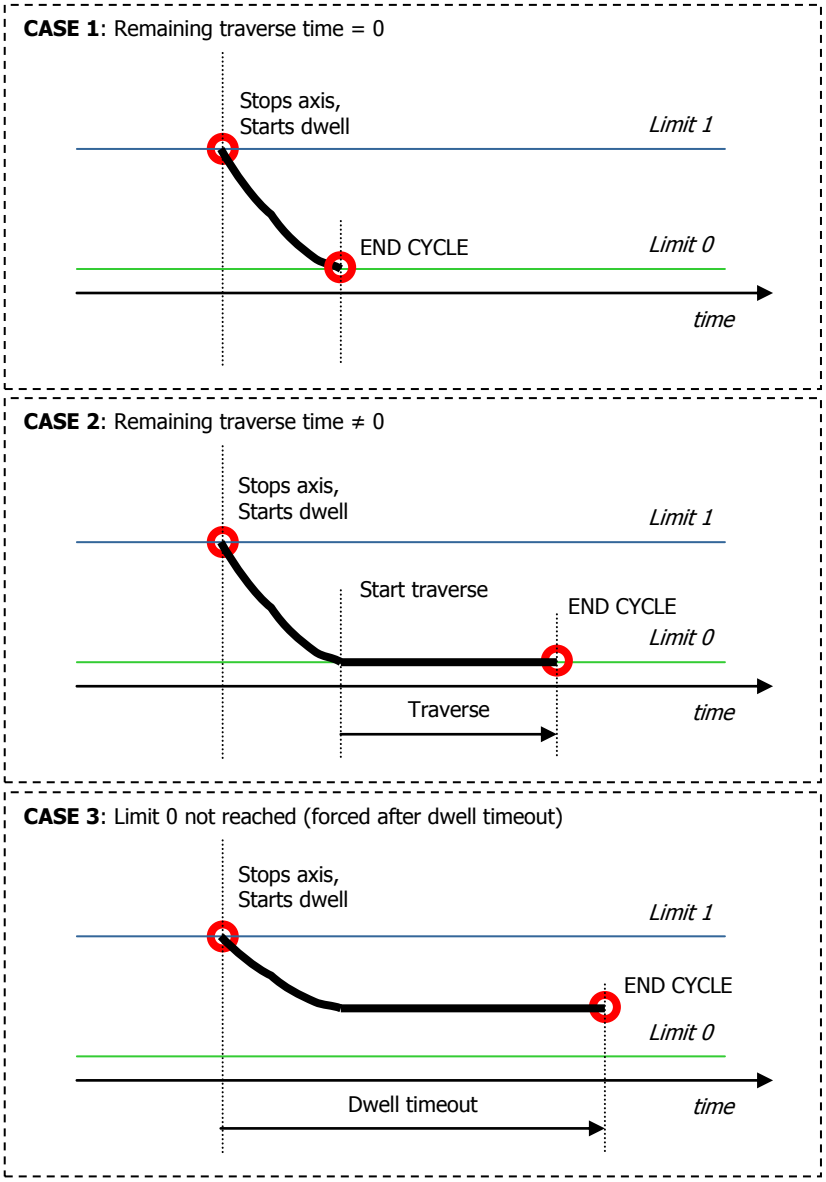
For each part-program, up to six signalling commands are available. Hereafter, a typical case of external gauging is described as an example. The four limits can be imposed at the level of four quote values, diminishing gradually towards zero. Each signalling of passing the limits determines a particular action of the NCU of the machine, when operating in automatic, or of the operator in manual mode. These typical actions could be:

LIMIT 4 Reduces the infeed (starts *roughing*).
LIMIT 3 Reduces the infeed (starts *finishing*).
LIMIT 2 Reduces the infeed (starts *super-finishing*).
LIMIT 1 Stops axis (starts *dwell or spark-out*).
LIMIT 0 Reports dimension at size (*end cycle*).
LIMIT A Reports dimension under-sized (*WARNING*).

While the first three signallings happen contemporarily when reaching the respective dimensions, the signalling of the fourth limit after an intentional delay, which permits to terminate the phase of dwell, or in other words to finish the work on the whole circumference of the piece, and to terminate the traverse passing on the piece.

The complete process is shown in the following diagram.




CASE 1: Remaining traverse time = 0
Stops axis,
Starts dwell
Limit 1
END CYCLE
Limit 0
time
CASE 2: Remaining traverse time ≠ 0
Stops axis,
Starts dwell
Limit 1
Start traverse
END CYCLE
Limit 0
Traverse
time
CASE 3: Limit 0 not reached (forced after dwell timeout)
Stops axis,
Starts dwell
Limit 1
END CYCLE
Limit 0
Dwell timeout
time

ID	Parameter	Description
	Limit 4 **[0.200]**	Indicates the dimension regarding the fourth limit signal (roughing)
	Limit 3 **[0.080]**	Indicates the dimension regarding the third limit signal (finishing)
	Limit 2 **[0.040]**	Indicates the dimension regarding the second limit signal (super-finishing)
	Limit 1 **[0.010]**	Indicates the dimension regarding the first limit signal (dwell or spark-out)
	Limit 0 **[0.000]**	Indicates the reached size. Normally it is programmed as 0 and indicates the end of the cycle.
	Limit A **[-0.002]**	Indicates that the part is resulting under-sized. It is normally used as warning signal.

3.3.2.1.2 GRAPHICS & DISPLAY (NG only – HMI only)

	Parameter	Description
	Show transudcer graph **[OFF]**	Enables \ Disables gauge heads bar graphs view.
	Show debug **[OFF]**	Enables \ Disables debug variables view.
	Show quote graph **[OFF]**	Enables \ Disables gauge and offset values view.
	Label **[NONE]**	Customizable field for labeling the name of the process

3.3.3. PART-PROGRAM for IN-PROCESS GAUGING & ROUNDNESS

3.3.3.1. PART-PROGRAM 1 (up to 8)

How to prepare the part-program for smooth or interrupted surface.

- **PART PROGRAM**
  - Operating mode — IN-PROCESS
  - Roundness analysis — ON
  - Gauging cycle start delay
  - **MEASURE**
    - **FORMULA**
      - D = Kq (K2 G2 + .. + K4 G4)
    - Synchronism — OFF , 1, SOFTWARE, G2, G3, G4, DIMENSION
      - Workhead RPM
      - Mechanical delay
      - Electrical delay
      - Sampling sector
      - Blanking time
      - Gauge mode
      - Workpiece profile
      - Damping
      - Synchronized zero
    - Master deviation from zero
    - Dwell timeout (sparkout)
    - Remaining traverse time
    - **COMMANDS**
      - Limit 4
      - Limit 3
      - Limit 2
      - Limit 1
      - Limit 0
      - Limit A
  - **ROUNDNESS**
    - **ROUNDNESS FORMULA**
      - Rnd = K Gx
    - Synchronism
    - Deviation center
    - Component to calculate residual
    - **LIMITS**
      - L1 = Comp 1 > Val + Comp 2 < Val
      - L2 = Comp 3 > Val
      - L3 = Comp 4 > Val
    - **GRAPHICS & DISPLAY**
      - Resolution
      - Line style
      - Excentricity
      - Ovality
      - 3-lobe
      - 4-lobe
      - 5-lobe
      - Residual
  - **GRAPHICS & DISPLAY** (NG only – HMI only)
    - Show transducer graph
    - Show debug
    - Show quote graph
    - Label

ID	Parameter	Description
	Operating mode **[IN-PROCESS]**	**IN-PROCESS**: Check on dimension while the piece is being machined. **POST-PROCESS**: Check on dimension after the piece has been machined. **PRE-PROCESS**: Check on dimension before the piece has been machined.
	Roundness analysis **[OFF]**	**OFF**: Disabled. **ON**: In the in-process gauging, makes a roundness analysis on the work-piece during the dwell (spark-out) stage
	Gauging cycle start delay [s] **[0]**	Timer which delays the start of the measuring process, permitting the gauging heads to carry out the mechanical movement of approaching and resting stably on the workpiece.

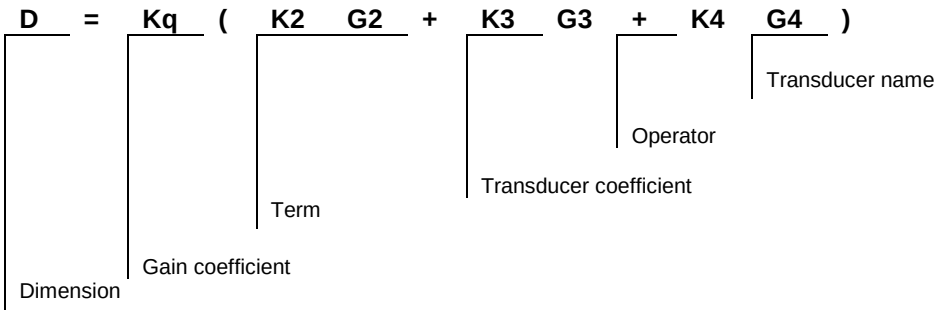
3.3.3.1.1 MEASURE

	Parameter	Description
	Synchronism **[OFF]**	**OFF:** Conventional gauging with continuous checking of the dimension. **1:** Synchronised gauging via the signal taken from the input dedicated to synchronism channel 1 on connector G8 (G6 on GA card). **SOFTWARE:** The sync signal is generated by software. A workpiece rpm is defined by a parameter **G2:** The sync signal is obtained comparing the measure of the gauge head G2 with a threshold **G3:** see above **G4:** see above **DIMENSION:** The sync signal is obtained comparing the dimension with a threshold
	Master deviation from zero [mm] **[0.0000]**	Indicates the deviation of the MASTER piece from quote zero. This permits production of pieces with small differences against the master piece. E.g. if one wishes to produce a circular piece with a plus tolerance of 0.020 mm, this parameter has to be imposed at -0.020.
	Dwell timeout (spark-out) [s] **[-0.1]**	Programmable timer, to force the signalling of limit 0, and which defines the end of the dwell stage (spark-out). This timer is activated at the moment of signalling limit 1 and cuts in, if the quote does not reach limit 0 within the preset time. The value “-1” disables the timer.
	Remaining traverse time [s] **[0.0]**	Necessary time for the grinding machine to carry out a complete passing on the whole longitudinal surface of the piece. This timer is counted from the moment the quote reaches limit 0 while the related command is kept frozen. At the end, the timer determines the activation of the signalling of limit 0.

3.3.3.1.1.1 Formula

The quote is defined by means of imposing a formula, with which the readings of the four transducers (G2, G3, G4) are combined.

The formula is made up of a maximum of 3 ‘‘terms’’. Each term represents the contribution to the gauging of each transducer. The terms of the formula are united by ‘‘operators’’. Each term is made up of two elements: ‘‘transducer coefficient: Kx’’ and ‘‘name of the transducer: Gx’’. Lastly, the overall effect of the terms is multiplied by a ‘‘gain coefficient: Kq’’.
The figure below shows the names used for describing the formula and is followed by a description of each element.



Transducer name

The four controllable transducers have the following names associated to the card inputs:

G2 = transducer for input G2.
G3 = transducer for input G3.
G4 = transducer for input G4.

Transducer coefficient (fine adjustment)

The role of the coefficient K2..K4 is that of carrying out a weighting correction of the reading done by the transducers. The value of such coefficients depends on the sensitivity and the mechanical construction of the transducer.
Normally the value of these coefficients is imposed at 1.0. But should it be necessary to correct them, it is possible to determine them with the following procedure:

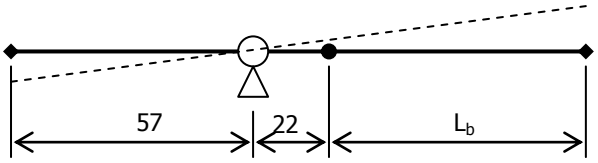
- Execute a zero on a reference surface position
- Insert a master piece with a known thickness, i.e. 0.2 mm, in between the tip and the reference surface;
- Read the displayed dimension, i.e. 0.22 mm
- Calculate the Kx coefficient (related to the current transducer: G2..G4) = Master dimension / Red dimension = 0.2 / 0.22 = 0.9091;
- Repeat this procedure for each transducer used

Operator

Identifies the type of link between the various transducers:
‘‘+’’ = The reading of the transducer that follows is added
‘‘-’’ = The reading of the transducer that follows is subtracted
‘‘)’’ = Terminates the formula.

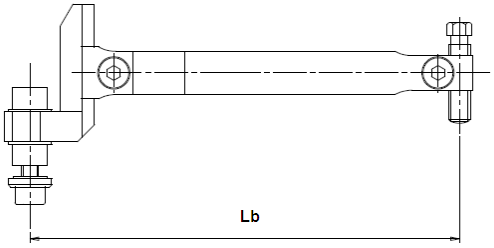
Gain coefficient (finger ratio)

Because the mobile mechanisms of the head carry out circular movements, the coefficient Kq determines an equalisation of the quote based on the finger ratio, i.e. the ratio between the distance gauging tip-fulcrum of the head and transducer-fulcrum of the head (see the following picture).



Kq = (Lb + 22) / 57 for gauging head type Top Gauge 200

where Lb is the finger length.



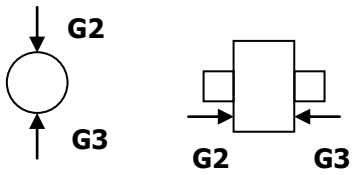
In the following table are displayed the gain coefficient for the standard finger set

Finger ratio	
Finger length Lb [mm]	**Kq for Top Gauge 200**
56	1.368
70	1.614
100	2.140
120	2.491

Alternatively to determine the Kq coefficient it is possible to apply the same procedure described for the transducer coefficients K2..K4.

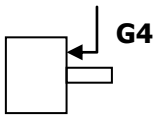
The following situations shown some typical examples of the use of the respective formulas:

Example 1 – Diameter or Thickness gauging using the transducer G2 and G3 and 70 mm finger length (Lb)



Formula: D = 1.614 (1.0 G2 + 1.0 G3)

Example 2 – Position gauging using the transducer G4 and 56 mm finger length (Lb)



Formula: D = 1.368 (1.0 G4)

3.3.3.1.1.2 SYNCHRONIZATION

The following parameters will appear in case of “Synchronism” not equal OFF. The unit of some parameter are defined depending on the type of synchronization.

	Parameter	Description
	Workpiece RPM **[0]**	It indicates the nominal value of the workpiece rotation speed to calculate the time base
	Mechanical delay **[0.0]**	It defines any delay (expressed as an angle) of settling in the mechanical parts of the gauging head, due to the presence of longitudinal discontinuities on the piece. It is calculated starting from the synchronism pulse.
	Electrical delay **[0.0]**	It defines any delay (expressed as an angle) of settling in the electronic conveyor for filtering the gauging. It is calculated starting from when the nominal mechanical delay ends (see above).
	Sampling sector **[360.0]**	It defines the length of the part of the piece (expressed as an angle) where gauging the dimension is to be carried out. The measurement is acquired starting from when any programmed delays end, as previously described.
	Blanking time **[0.0]**	It defines the area of the workpiece where you want to suspend the measure. The suspension begins at the expiration of the sampling sector.
	Gauge mode **[CONTINUE]**	Specifies which type of gauging is to be carried out inside the angle defined by the parameter SAMPLING SECTOR: **CONTINUE:** The dimension is updated in real time. **MAX:** The maximum dimension value is acquired on the sector of the gauging. **MIN:** The minimum dimension value is acquired on the sector of the gauging. **AVG:** The mean dimension value is acquired on the sector of the gauging.
	Workpiece profile **[PLAIN]**	It indicates the type of the surface profile to be measured **PLAIN**: Smooth continuous profile; **EVEN**: Interrupted with symmetric profile; **ODD**: Interrupted with asymmetric profile
	Damping **[0]**	**0 .. 5**: Filter with damping effect on the measurement. The higher the value, the greater the damping effect.
	Synchronized zero **[OFF]**	**OFF:** The zeroing procedure is made with the master piece in static condition; **ON:** The zeroing procedure is made with the master piece in dynamic condition (i.e. in rotation as the work piece).
	Measure update **[SINGLE]**	**SINGLE**: the measurement is updated due to a START / ENABLE command **CONTINUOUS**: The measure is continuously updated

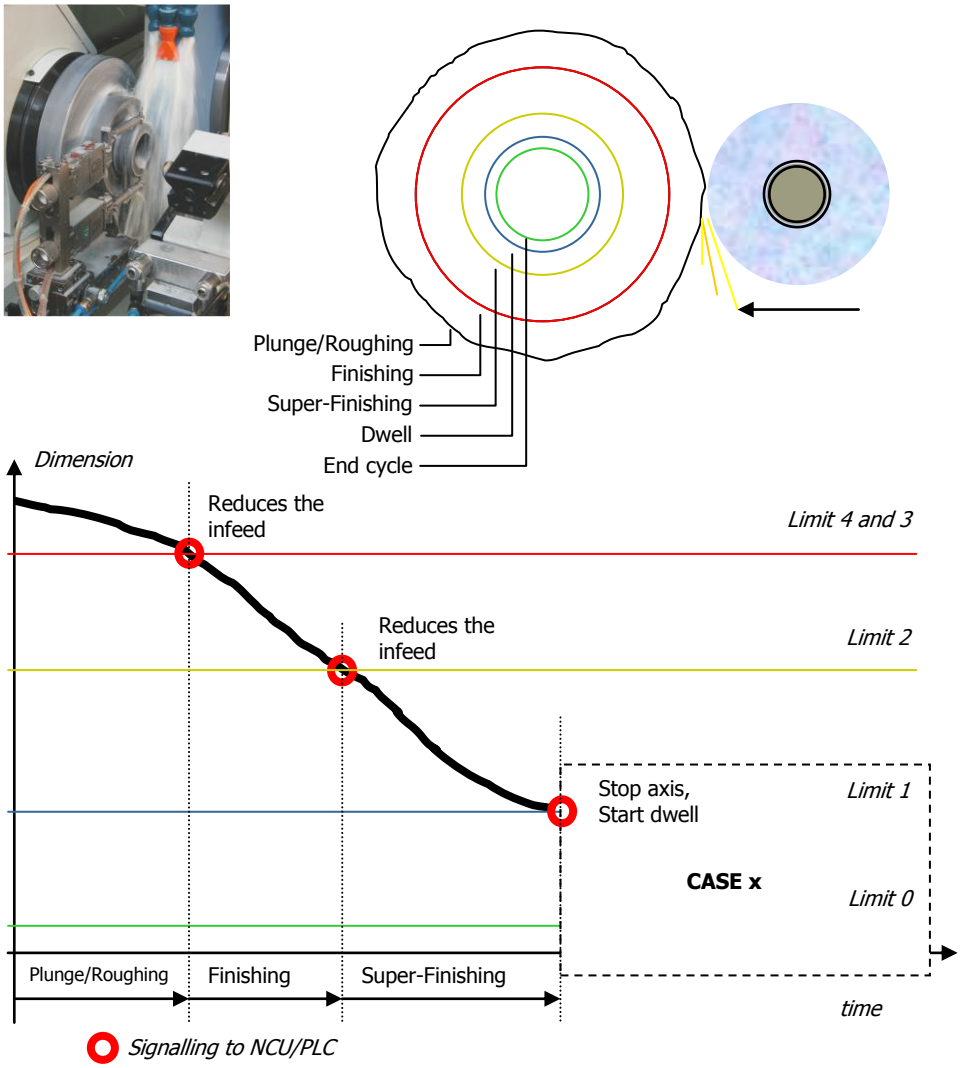
3.3.3.1.1.3 Commands

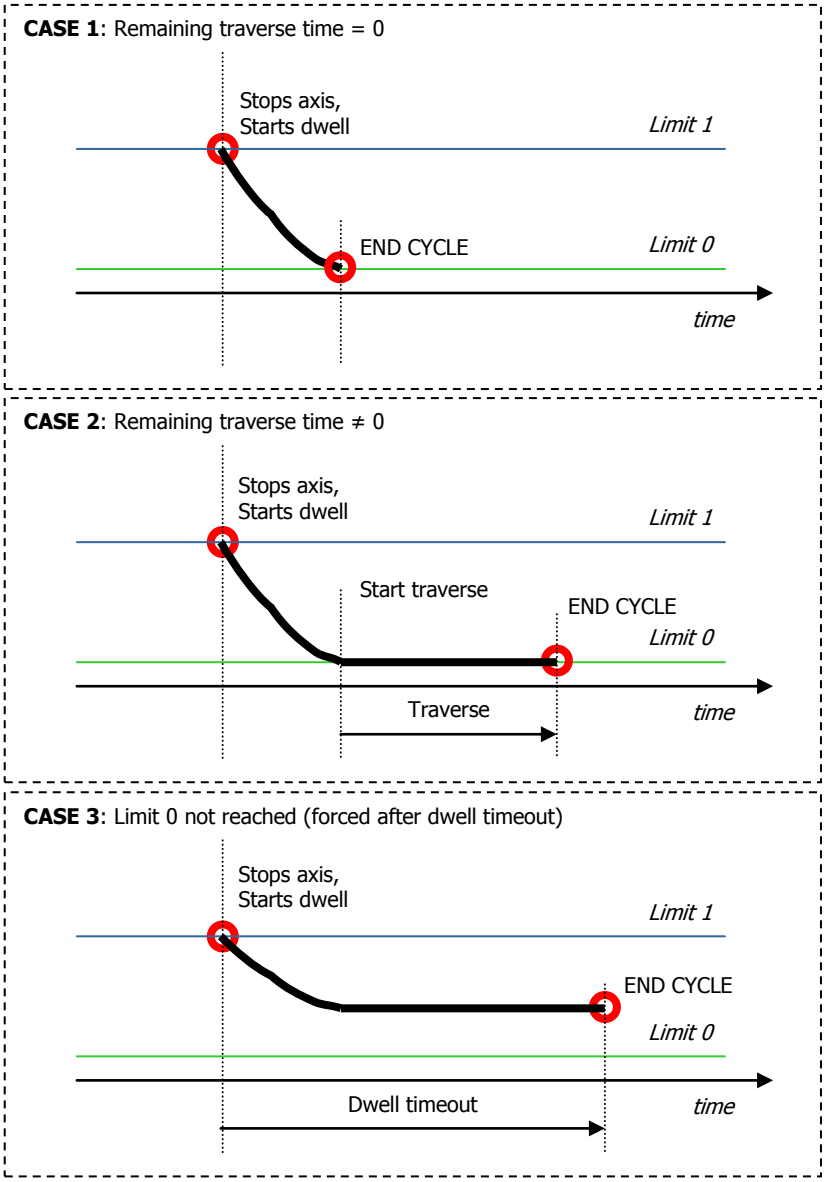
For each part-program, up to six signalling commands are available. Hereafter, a typical case of external gauging is described as an example. The four limits can be imposed at the level of four quote values, diminishing gradually towards zero. Each signalling of passing the limits determines a particular action of the NCU of the machine, when operating in automatic, or of the operator in manual mode. These typical actions could be:

LIMIT 4 Reduces the infeed (starts *roughing*)
LIMIT 3 Reduces the infeed (starts *finishing*)
LIMIT 2 Reduces the infeed (starts *super-finishing*)
LIMIT 1 Stops axis (starts *dwell or spark-out*)
LIMIT 0 Reports dimension at size (*end cycle*)
LIMIT A Reports dimension under-sized (*WARNING*)

While the first three signallings happen contemporarily when reaching the respective dimensions, the signalling of the fourth limit after an intentional delay, which permits to terminate the phase of dwell, or in other words to finish the work on the whole circumference of the piece, and to terminate the traverse passing on the piece.

The complete process is shown in the following diagram.

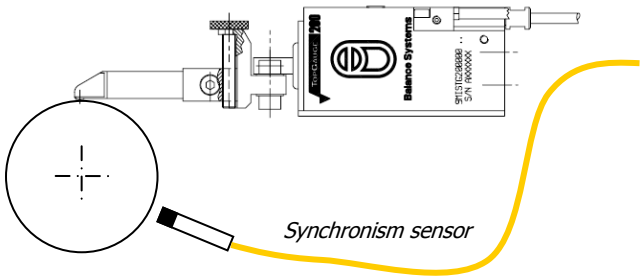



CASE 1: Remaining traverse time = 0
Stops axis,
Starts dwell
Limit 1
END CYCLE
Limit 0
time
CASE 2: Remaining traverse time ≠ 0
Stops axis,
Starts dwell
Limit 1
Start traverse
END CYCLE
Limit 0
Traverse
time
CASE 3: Limit 0 not reached (forced after dwell timeout)
Stops axis,
Starts dwell
Limit 1
END CYCLE
Limit 0
Dwell timeout
time

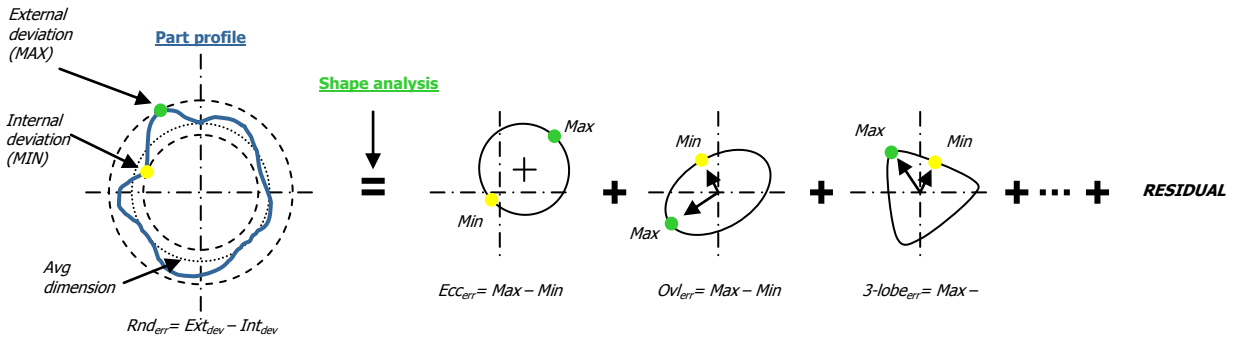
ID	Parameter	Description
	Limit 4 **[0.200]**	Indicates the dimension regarding the fourth limit signal (roughing)
	Limit 3 **[0.080]**	Indicates the dimension regarding the third limit signal (finishing)
	Limit 2 **[0.040]**	Indicates the dimension regarding the second limit signal (super-finishing)
	Limit 1 **[0.010]**	Indicates the dimension regarding the first limit signal (dwell or spark-out)
	Limit 0 **[0.000]**	Indicates the reached size. Normally it is programmed as 0 and indicates the end of the cycle.
	Limit A **[-0.002]**	Indicates that the part is resulting under-sized. It is normally used as warning signal.

3.3.3.1.2 ROUNDNESS

The roundness and shape analysis is performed through a syncronized gauging function which uses a gauge head and a synchronism sensor.



- It is added to an in-process part-program (i.e. Diameter)
- The roundness analysis starts automatically with the FINISHING phase.
- The runout error is evaluated at the end of the dwell (spark-out)
- The maximum rotation speed of the work-piece is 700 rpm



ID	Parameter	Description
	Synchronism [1]	**1**: Synchronised gauging via the signal taken from the input dedicated to synchronism channel 1 on connector G6. **2**: As above, with the signal taken from channel 2.
	Deviations center [THEORETICAL]	In compliance with the ISO 6318 and ISO 4291 norms, it is possible to define the error in roundness both compared to the ideal centre of the workpiece, and compared to the real centre. **THEORETICAL**: The roundness error comprises the eccentricity element. The roundness takes reference from the centre of the tailstock on which the workpiece rotates. **REAL**: The roundness error is drawn from the eccentricity element. The roundness takes reference from the real centre of the workpiece.
	Component to calculate residual [0]	This represents the limit of order (or harmonic limit) beyond which the residual effect of the shape is to be evaluated. It is a parameter linked to an empirical method that makes it possible to approximately enhance (due to the presence of the noise of gauging) the harmonic effect of the upper order that identifies the presence of vibrations on the surface of the finished workpiece.

3.3.3.1.2.1 Roundness formula

The gauging of roundness is defined by setting a formula, of a single term, where one of the four transducers is selected (G2, G3, G4, G5). The structure of the formula is as follows:

Rnd = K Gx dove x = 2, 3, 4.

the meaning of coefficient K can be summarised: K = Kq Kx (see measure formula).
The role of coefficient K is that of weighing up the reading made by the transducer. The coefficient value is normally supplied in the technical sheet for the gauging head, since it depends on the sensitivity and mechanical construction of the transducer.
The value of this coefficient can be set using the previously described procedure for the measure formula.

Example: Formula for finger Lb = 70mm : **Rnd = 1.614 G2**

3.3.3.1.2.2 Limits

When analysing post-process roundness it is possible to define the type of signalling associated to the automatic outputs L1, L2, L3 in terms of deviation, value of the form elements of minor order (eccentricity, ovality, 3-lobe, 4-lobe, 5-lobe), or the fixed residual value for a certain component.

The output signals are defined through three ‘‘formulas’’, one for each output available.
The formula for output L1 is made up, at the most, of two terms.
The formulas for outputs L2 and L3 are made up, at the most, of one single term.
Each term represents the management of a limit, which is to be taken as a condition for signalling the condition.
The terms of the formula for S1 can be joined by an ‘‘operator’’ with the functionality of logic OR.
Each term of the formula is made up of three elements: ‘‘component’’, ‘‘comparison symbol’’, ‘‘value’’.

L1 = COMPONENT > VALUE + COMPONENT < VALUE
L2 = COMPONENT > VALUE
L3 = COMPONENT > VALUE

Example: to check a roundness error in terms of rise and recess and, at the same time, to evaluate the ovality and the 3-lobe, the automatic outputs must be programmed as follows:

L1 = EXTERNAL DEVIATION > 0.0100 + INTERNAL DEVIATION < -0.0100
L2 = OVALITY > 0.0030
L3 = 3-LOBE > 0.0020

ID	Parameter	Description
	Internal deviation	This defines the maximum tolerance value for a ‘‘recess’’ compared to a perfectly circular profile.
	External deviation	This defines the maximum tolerance value for a ‘‘rise’’ compared to a perfectly circular profile.
	Eccentricity	This defines the maximum tolerance for the eccentricity
	Ovality	This defines the maximum tolerance for the ovality
	3-lobe	This defines the maximum tolerance for the 3-lobe shape
	4-lobe	This defines the maximum tolerance for the 4-lobe shape
	5-lobe	This defines the maximum tolerance for the 5-lobe shape
	Residual	This defines the maximum tolerance for the higher-lobe shape

3.3.3.1.2.3 Graphics & Display

ID	Parameter	Description
	Resolution [mm/pixel] **[0.0002]**	Defines the roundness diagram displaying resolution (mm/pixel). This is only a displaying parameter. The lower the set value, the higher the graph resolution.
	Line style **[FINE]**	Defines the line style (**FINE** / **BOLD**) used to draw the work-piece profile.
	Eccentricity **[ON]**	Enables the display of the eccentricity component value
	Ovality **[ON]**	Enables the display of the ovality component value
	3-lobe **[ON]**	Enables the display of the three-lobed component value
	4-lobe **[OFF]**	Enables the display of the four-lobed component value
	5-lobe **[OFF]**	Enables the display of the five-lobed component value
	Residual **[OFF]**	Enables the display of the residual component value

3.3.3.1.3 GRAPHICS & DISPLAY (NG only – HMI only)

	Parameter	Description
	Show transudcer graph **[OFF]**	Enables \ Disables gauge heads bar graphs view.
	Show debug **[OFF]**	Enables \ Disables debug variables view.
	Show quote graph **[OFF]**	Enables \ Disables gauge and offset values view.
	Label **[NONE]**	Customizable field for labeling the name of the process

3.3.4. PART-PROGRAM for POST-PROCESS PART SIZE CHECKING

How to prepare the part-program for smooth or interrupted surface.

- **PART PROGRAM**
  - Operating mode — POST-PROCESS
  - Roundness analysis — OFF
  - Gauging cycle start delay
  - **MEASURE**
    - **FORMULA**
      - D = Kq (K2 G2 + .. + K4 G4)
    - Synchronism — OFF , 1, SOFTWARE, G2, G3, G4, DIMENSION
    - **SYNCHRONIZATION**
      - Workhead RPM
      - Mechanical delay
      - Electrical delay
      - Sampling sector
      - Blanking time
      - Gauge mode
      - Workpiece profile
      - Damping
      - Synchronized zero
      - Measure update
    - Master deviation from zero
    - Dimension stability timer
    - Dimension stability tolerance
    - Dimension stability timeout
    - **LIMITS**
      - Limit type
      - Upper specification limit
      - Upper compensation limit ++
      - Upper compensation limit +
      - Lower compensation limit –
      - Lower compensation limit - -
      - Lower specification limit
  - **GRAPHICS & DISPLAY** (NG only – HMI only)
    - Show transducer graph
    - Show debug
    - Show quote graph
    - Label

3.3.4.1. PART-PROGRAM 1 (up to 8)

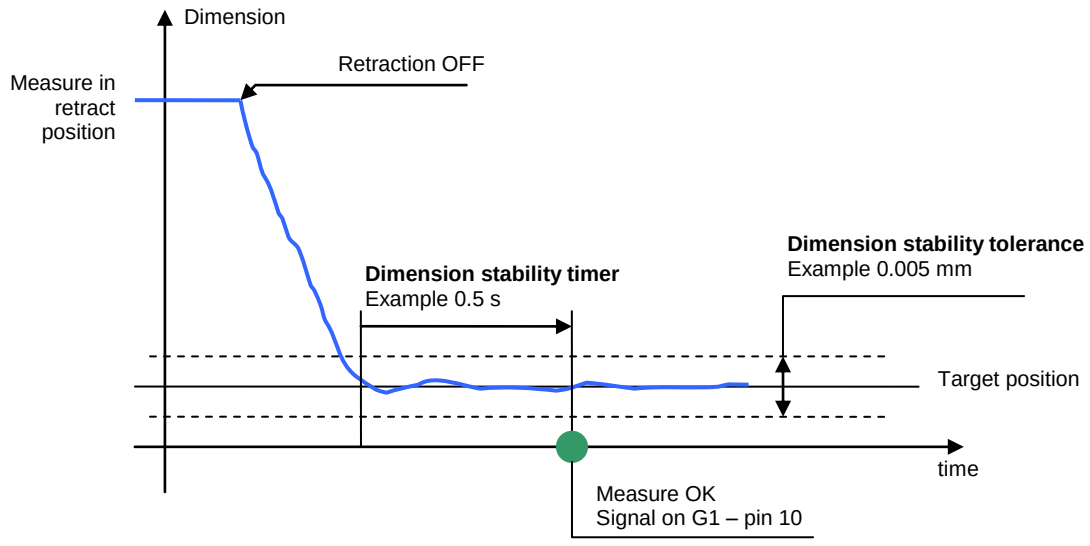
	Parameter	Description
	Operating mode **[IN-PROCESS]**	**IN-PROCESS**: Check on dimension while the piece is being machined. **POST-PROCESS**: Check on dimension after the piece has been machined. **PRE-PROCESS**: Check on dimension before the piece has been machined.
	Roundness analysis **[OFF]**	**OFF**: Disabled. **ON**: In the in-process gauging, makes a roundness analysis on the work-piece during the dwell (spark-out) period
	Gauging cycle start delay [s] **[0]**	Timer which delays the start of the measuring process, permitting the gauging heads to carry out the mechanical movement of approaching and resting stably on the workpiece.

3.3.4.1.1 MEASURE

	Parameter	Description

	Synchronism **[OFF]**	**OFF:** Conventional gauging with continuous checking of the dimension. **1:** Synchronised gauging via the signal taken from the input dedicated to synchronism channel 1 on connector G8 (G6 on GA card). **SOFTWARE:** The sync signal is generated by software. A workpiece rpm is defined by a parameter **G2:** The sync signal is obtained comparing the measure of the gauge head G2 with a threshold **G3:** see above **G4:** see above **DIMENSION:** The sync signal is obtained comparing the dimension with a threshold
	Master deviation from zero [mm] **[0.0000]**	Indicates the deviation of the MASTER piece from quote zero. This permits production of pieces with small differences against the master piece. E.g. if one wishes to produce a circular piece with a plus tolerance of 0.020 mm, this parameter has to be imposed at -0.020.
	Dimension stability timer [s] **[1.0]**	Time required for the establishment of measurement until the dimension may considered valid in the limits programmed by the parameter “DIMENSION STABILITY TOLERANCE”.
	Dimension stability tolerance [mm] **[0.005]**	Maximum deviation (positive or negative) allowed to the measurement until the dimension is considered stable or valid.
	Dimension stability timeout [s] **[1.5]**	Max time allowed to reach the dimension stability

The following parameters allow the DATA VALID signalling (dimension valid)



3.3.4.1.1.1 SYNCHRONIZATION

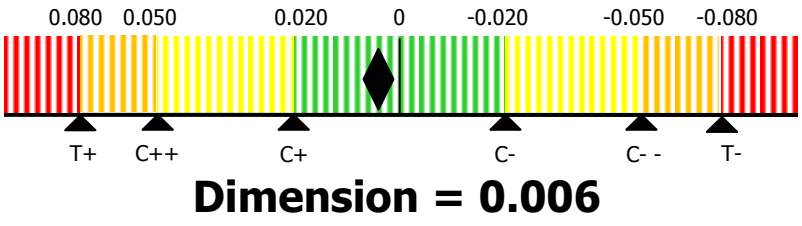
The following parameters will appear in case of “Synchronism” not equal OFF. The unit of some parameter are defined depending on the type of synchronization.

	Parameter	Description
	Workpiece RPM **[0]**	It indicates the nominal value of the workpiece rotation speed to calculate the time base
	Mechanical delay **[0.0]**	It defines any delay (expressed as an angle) of settling in the mechanical parts of the gauging head, due to the presence of longitudinal discontinuities on the piece. It is calculated starting from the synchronism pulse.
	Electrical delay **[0.0]**	It defines any delay (expressed as an angle) of settling in the electronic conveyor for filtering the gauging. It is calculated starting from when the nominal mechanical delay ends (see above).
	Sampling sector **[360.0]**	It defines the length of the part of the piece (expressed as an angle) where gauging the dimension is to be carried out. The measurement is acquired starting from when any programmed delays end, as previously described.
	Blanking time **[0.0]**	It defines the area of the workpiece where you want to suspend the measure. The suspension begins at the expiration of the sampling sector.
	Gauge mode **[CONTINUE]**	Specifies which type of gauging is to be carried out inside the angle defined by the parameter SAMPLING SECTOR: **CONTINUE:** The dimension is updated in real time. **MAX:** The maximum dimension value is acquired on the sector of the gauging; **MIN:** The minimum dimension value is acquired on the sector of the gauging; **AVG:** The mean dimension value is acquired on the sector of the gauging.
	Workpiece profile **[PLAIN]**	It indicates the type of the surface profile to be measured **PLAIN**: Smooth continuous profile **EVEN**: Interrupted with symmetric profile **ODD**: Interrupted with asymmetric profile
	Damping **[0]**	**0 .. 5**: Filter with damping effect on the measurement. The higher the value, the greater the damping effect.
	Synchronized zero **[OFF]**	**OFF:** The zeroing procedure is made with the master piece in static condition. **ON:** The zeroing procedure is made with the master piece in dynamic condition (i.e. in rotation as the work piece).

3.3.4.1.1.2 Formula

See descriptions for IN-PROCESS part-program.

3.3.4.1.1.3 Limits



ID	Parameter	Description
	Upper specification limit [mm] **[0.050]**	Indicates the tolerance limit beyond which the workpiece being tested is rejected.
	Upper compensation limit ++ [mm] **[0.035]**	Indicates that the workpiece being tested is within the machining tolerance, but is near to reaching the upper tolerance limit.
	Upper compensation limit + [mm] **[0.020]**	Indicates that the workpiece being tested is within the machining tolerance, but is near to reaching the upper tolerance limit.
	Lower compensation limit – [mm] **[-0.020]**	Indicates that the workpiece being tested is within the machining tolerance, but is near to reaching the lower tolerance limit.
	Lower compensation limit – - [mm] **[-0.035]**	Indicates that the workpiece being tested is within the machining tolerance, but is near to reaching the lower tolerance limit.
	Lower specification limit [mm] **[-0.050]**	Indicates the tolerance limit below which the workpiece being tested is rejected.

3.3.4.1.2 GRAPHICS & DISPLAY (NG only – HMI only)

	Parameter	Description
	Show transudcer graph **[OFF]**	Enables \ Disables gauge heads bar graphs view.
	Show debug **[OFF]**	Enables \ Disables debug variables view.
	Show quote graph **[OFF]**	Enables \ Disables gauge and offset values view.
	Label **[NONE]**	Customizable field for labeling the name of the process

3.3.5. PART-PROGRAM for POST-PROCESS ROUNDNESS & SHAPE ANALYSIS

How to prepare the part-program for smooth or interrupted surface.

- **PART PROGRAM**
  - Operating mode — POST-PROCESS
  - Roundness analysis — ON
  - Gauging cycle start delay
  - **ROUNDNESS**
    - **ROUNDNESS FORMULA**
      - Rnd = K Gx
    - Synchronism
    - Deviation center
    - Component to calculate residual
    - **LIMITS**
      - L1 = Comp 1 > Val + Comp 2 < Val
      - L2 = Comp 3 > Val
      - L3 = Comp 4 > Val
    - **GRAPHICS & DISPLAY**
      - Resolution
      - Line style
  - **GRAPHICS & DISPLAY** (NG only – HMI only)
    - Show transducer graph
    - Show debug
    - Show quote graph
    - Label

3.3.5.1. PART-PROGRAM 1 (up to 8)

	Parameter	Description
	Operating mode **[IN-PROCESS]**	**IN-PROCESS**: Check on dimension while the piece is being machined. **POST-PROCESS**: Check on dimension after the piece has been machined. **PRE-PROCESS**: Check on dimension before the piece has been machined.
	Roundness analysis **[OFF]**	**OFF**: Disabled. **ON**: In the in-process gauging, makes a roundness analysis on the work-piece during the dwell (spark-out) period
	Gauging cycle start delay [s] **[0]**	Timer which delays the start of the measuring process, permitting the gauging heads to carry out the mechanical movement of approaching and resting stably on the workpiece.

3.3.5.1.1 ROUNDNESS

See descriptions for IN-PROCESS part-program.

3.3.5.1.2 GRAPHICS & DISPLAY (NG only – HMI only)

See descriptions for IN-PROCESS part-program.

3.3.6. PART PROGRAM for PRE-PROCESS

3.3.6.1. PART-PROGRAM 1 (up to 8)

Offset increment step
PART PROGRAM
Operating mode PRE-PROCESS
Gauging cycle start delay
MEASURE
FORMULA
D = Kq (Kx Gx)
Synchronism
Master deviation from zero
Dimension stability timer
Dimension stability tolerance
Dimension stability timeout
LIMITS
Lower limit
Upper limit
GRAPHICS & DISPLAY (NG only – HMI only)
Show transducer graph
Show debug
Show quote graph
Label

ID	Parameter	Description
	Operating mode **[IN-PROCESS]**	**IN-PROCESS**: Check on dimension while the piece is being machined. **POST-PROCESS**: Check on dimension after the piece has been machined. **PRE-PROCESS**: Check on dimension before the piece has been machined.
	Gauging cycle start delay [s] **[0.0]**	Timer which delays the start of the measuring process, permitting the gauging heads to carry out the mechanical movement of approaching and resting stably on the workpiece.

3.3.6.1.1 MEASURE

	Parameter	Description
	Synchronism **[OFF]**	**OFF:** Conventional gauging with continuous checking of the dimension. **1:** Synchronised gauging via the signal taken from the input dedicated to synchronism channel 1 on connector G8 (G6 on GA card). **SOFTWARE:** The sync signal is generated by software. A workpiece rpm is defined by a parameter **G2:** The sync signal is obtained comparing the measure of the gauge head G2 with a threshold **G3:** see above **G4:** see above **DIMENSION:** The sync signal is obtained comparing the dimension with a threshold
	Master deviation from zero [mm] **[0.0000]**	Indicates the deviation of the MASTER piece from quote zero. This permits production of pieces with small differences against the master piece. E.g. if one wishes to produce a circular piece with a plus tolerance of 0.020 mm, this parameter has to be imposed at -0.020.
	Dimension stability timer [s] **[1.0]**	Time required for the establishment of measurement until the dimension may considered valid in the limits programmed by the parameter “DIMENSION STABILITY TOLERANCE”.
	Dimension stability tolerance [mm] **[0.005]**	Maximum deviation (positive or negative) allowed to the measurement until the dimension is considered stable or valid.
	Dimension stability timeout [s] **[1.5]**	Max time allowed to reach the dimension stability

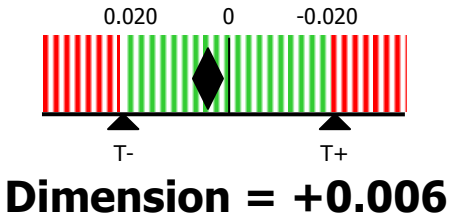
3.3.6.1.1.1 Formula

See descriptions for IN-PROCESS part-program.

3.3.6.1.1.2 SYNCHRONIZATION

See descriptions for POST-PROCESS part-program.

3.3.6.1.1.3 Limits



ID	Parameter	Description
	Upper limit [mm] **[0.050]**	Indicates the tolerance limit beyond which the workpiece being tested is rejected.
	Lower limit [mm] **[-0.050]**	Indicates the tolerance limit below which the workpiece being tested is rejected.

3.3.6.1.2 GRAPHICS & DISPLAY (NG only – HMI only)

See descriptions for IN-PROCESS part-program.

4. Appendix

Documents referred to in the text		
Name document	**Paragraphs**	**Link**
Interfaccia segnali	1.1.2, 2.2.1, 2.2.1.1	9UMEN2521-1100 YYMMDD Signals Interface v110 En.pdf
Componenti	2.2.1.1	9UMEN2506-1200 VM25 Components.pdf