

## SPECIFICATIONS

### MAIN DEVICE FEATURES

1. On-line calculation, display and transmission of up to 7 massecuite parameters and up to 4 additional monitored data during sugar crystallization for up to 2 pans simultaneously.
2. Automatic seeding of vacuum pans based on calculated supersaturation or density and on the set-point for seeding selected by the local technologist.
3. Collecting all calculated and measured data for the last 4 strikes in strike history archives, which can be displayed as trends with appropriate time data. Brief (numerical) supersaturation strike history (last 4 strikes).
4. Advanced communication features including the Ethernet.
5. Large LCD numeric and graphic display, robust design.

### DATA AVAILABLE FOR TRANSMISSION

#### 1. CALCULATED DATA (ALL OVER A COMPLETE STRIKE)

- |                         |                        |
|-------------------------|------------------------|
| 1. Supersaturation      | [-]                    |
| 2. Crystal content      | [% by volume]          |
| 3. Density              | [kg / m <sup>3</sup> ] |
| 4. Consistency          | [%]                    |
| 5. Solids content       | [%]                    |
| 6. Mother liquor purity | [%]                    |
| 7. Mean crystal size    | [mm]                   |

#### 2. ADDITIONAL DATA MONITORED IN REAL TIME

- |  |            |
|--|------------|
| 1. Syrup / mother liquor concentration | [%]        |
| 2. Stirrer motor consumption (if used) | [kW, or A] |
| 3. Temperature                         | [°C]       |
| 4. Level (optional)                    | [%]        |

### INPUTS FOR CALCULATION

#### 1. PROCESS INPUTS

1. Syrup / mother liquor concentration (measured by the K-PATENTS refractometer)
2. Massecuite temperature (measured by the K-PATENTS refractometer, or by a separate transmitter).
3. Third party transmitter measuring
  - a) density, OR
  - b) massecuite solids content, OR
  - c) stirrer motor power, or current consumption.
4. Optional input: massecuite level.

#### 2. DIGITAL (ON / OFF) INPUTS (DEPENDING ON THE MODE OF THE SELECTED OPERATION)

1. None.
2. Maximum 2 (DIN1: "Strike active", DIN2: "Seeded").

#### 3. LABORATORY DATA

1. Feed syrup purity [%]
2. Syrup quality ("m", "b", "c") parameters. Typical data and a description of the procedure to determine local parameters are provided.

All inputs can be also received via the communication interfaces.

### CALCULATED OUTPUTS

#### 1. ANALOG (0-20, 4-20 mA) OUTPUTS

Any 2 out of the 7 calculated massecuite parameters (per pan).

#### 2. DIGITAL (ON / OFF) OUTPUTS

1. DO1: Warning on approaching seeding.
2. DO2: Opening the seeding valve for a selected time interval.

All calculated and measured data can be also accessed via the communication interfaces.

Process Control Kft. may make changes to specifications and product descriptions at any time, without notice!

### PROCESS INTERFACE

#### INPUTS

1. **ANALOG CURRENT** 8 channels  
Symmetrical, galvanically isolated  
Range 0(4) – 20 mA (keyboard selectable)  
Input impedance 100 Ω  
Comm. mode voltage 50 V max.
2. **RTD (Pt 100)** 2 channels, optional  
4 wire connecting mode
3. **DIGITAL (ON / OFF)** 8 channels  
Signal sources  
passive, contact or open collector  
active, + 24V<sub>DC</sub>  
Automatic signal detection

#### OUTPUTS

1. **ANALOG CURRENT** 4 channels  
Galvanically isolated  
Range 0 – 20 mA, 4 – 20 mA (keyboard selectable)  
Max. load 600 Ω
2. **DIGITAL (ON / OFF)** 4 channels  
Isolated open collector,  
overvoltage and  
short circuit protected  
Max. load 100 mA, 40 V<sub>DC</sub>
3. **POWER SUPPLY FOR TRANSMITTERS**  
1 X 24 V<sub>DC</sub>, 200 mA max.

### COMMUNICATION INTERFACES

1. **SERIAL (COM1, COM2, COM3)** 3 pcs.  
Galvanically isolated ports  
Standards RS232, RS422, RS485 (keyboard select.)  
Control signals CTS, RTS (keyboard selectable)  
Baud rates 1200...38400 (keyboard selectable)  
Length of cable RS232 15 m max.  
RS422 / 485 1200 m max.  
Protocols K-PATENTS refractometer protocol  
MODBUS SLAVE (ASCII, RTU)
2. **ETHERNET 10 / 100 BaseT**  
Connector RJ45  
Protocols TCP / IP, MODBUS TCP,  
UDP / IP (K-PATENTS refractometer prot.)

#### FRONT PANEL

DISPLAY 5.7" QVGA 320x240 graphic LCD  
KEYBOARD Membrane switches with flexible foil cover  
LED INDICATORS Power, Run, Alarm

#### POWER SUPPLY

100 - 240 V<sub>AC</sub>, 50 - 60 Hz; 10-25 VA  
24 (18 – 30) V<sub>DC</sub>

#### TEMPERATURE RANGE (AMBIENT)

Operation 0 ... 50 °C  
Storage - 25 ... 70 °C

#### ENCLOSURE

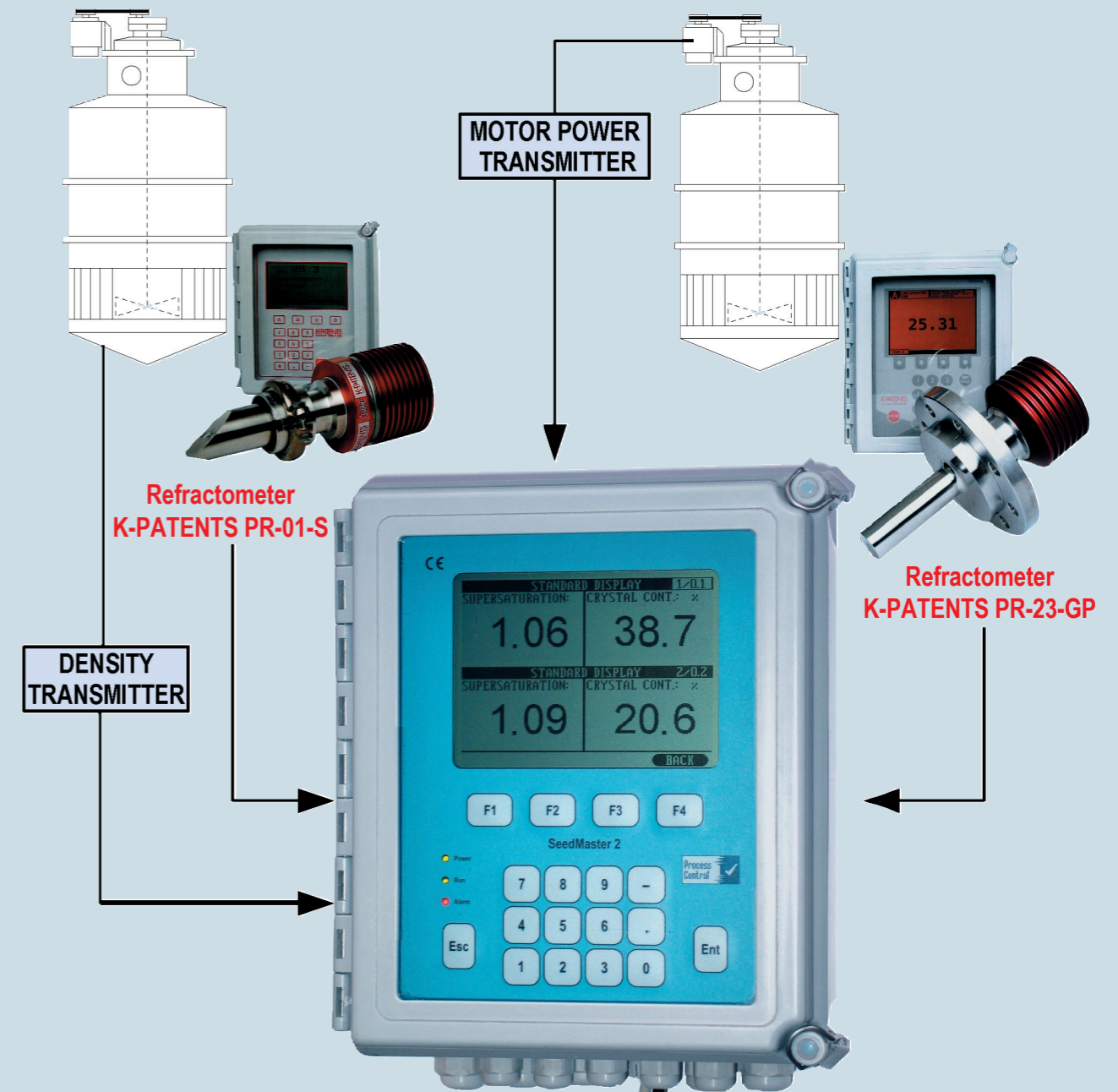
IP66, NEMA 4X,  
Size (mm / inch): H: 267 / 10.5; W: 226 / 8.9; D: 159 / 6.25

# SeedMaster 2

## CRYSTALLIZATION TRANSMITTER AND SEEDING DEVICE



Sweeten Your Profits ...



With The Right Instruments For Crystallization Control

The **SeedMaster 2** Crystallization Transmitter And Seeding Device was designed to provide all of the vital information required to control the process of sugar crystallization on an unprecedented level.

It can serve 2 vacuum pans simultaneously.

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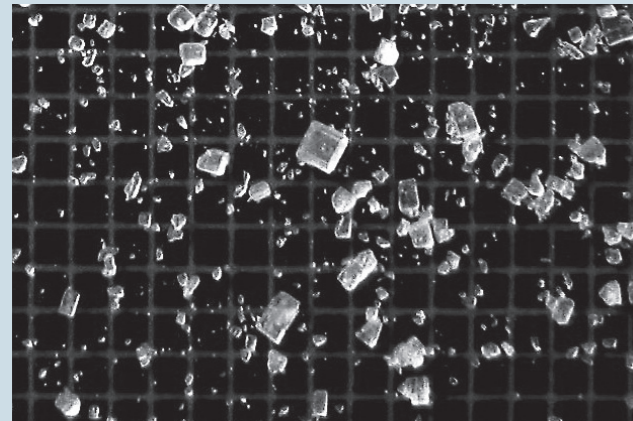
## SUGAR CRYSTALLIZATION BASICS

Crystallization is a very important part of sugar manufacturing. This is a process, which has a large influence on product quality and on the cost of production, both of which are very important when competitiveness is at stake. Modern control of crystallization must rely on the reliable on-line measurement of the parameters, which are vital in the control of the process performed by a local operator (manual control), or by an advanced automatic process control system (PCS).

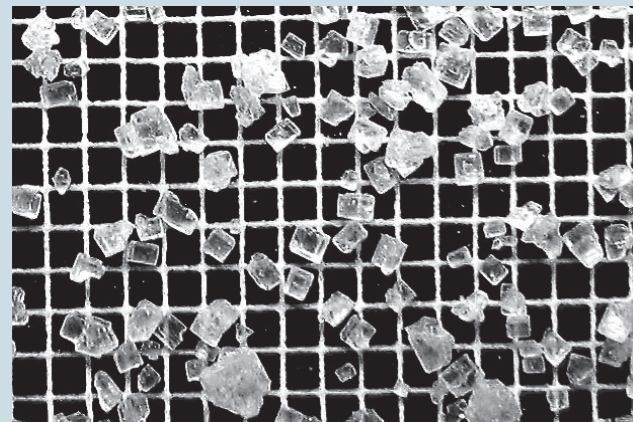
**Supersaturation** is the driving force of crystallization: crystal growth (speed of crystallization) depends very much on this parameter. High supersaturation means faster crystal growth and vice-versa. It has also been proved that excessive supersaturation results in poor crystal quality (fines and conglomerates). These are melted, concentrated (re-circulated) and crystallized again, the end result of which is

- waste of time and energy,
- decreased effective yield of product sugar per strike and shift,
- increased use of water and
- increased cost of production.

This is proved by the observation of crystal photographs showing the presence of fines and conglomerates of different sizes.

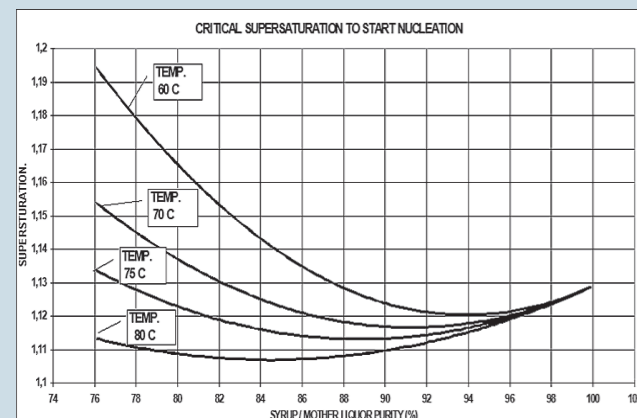


Large amount of fines



Conglomerates

Fines and conglomerates will be created all over the strike, whenever supersaturation exceeds a critical limit, where spontaneous nucleation will be started.



(This figure is based on the equation published in: M.Saska: Boiling point elevation of technical sugar cane solutions and its use in automatic pan boiling. International Sugar Journal 2002, VOL. 104., No.1247., 500-507).

Advanced control of sugar crystallization requires the fairly accurate in-line monitoring of supersaturation in real time all over the complete process of crystallization.

Besides supersaturation information correlated to crystal content of the massecuite, that is a second massecuite parameter monitored in real time is also required.

**Supersaturation** is defined as the amount of sugar dissolved divided by the amount of sugar required for saturation in the same amount of water at the same temperature. We have real supersaturation only if this ratio is larger than 1,0 (saturation). Supersaturation is a complex multivariable function of the liquid phase (mother liquor) parameters and should be calculated taking into account all of its governing parameters:

$$\text{SUPERSATURATION} = f(\text{C, Q, T, m, b, c})$$

where:

- C syrup / mother liquor concentration [%]
- Q syrup / mother liquor purity [%]
- T temperature [°C]
- m, b, c syrup quality parameters

It follows from its definition that, among others, concentration of the mother liquor should be measured on-line, undisturbed by the presence of crystals in the massecuite in order to be able to calculate it.

Common sensors used in crystallization control (conductivity, consistency, massecuite density or solids content (nuclear or microwave), radio frequency (RF), liquor concentration (refractometer)) provide data only on a single massecuite parameter. Naturally enough, and, contrary to occasional (and misleading) claims, none of these parameters can be used in advanced control as a substitute to real supersaturation, the most important parameter in crystallization. Most of these sensors provide indirect, approximate data correlated to crystal content.

## SeedMaster 2 THE CRYSTALLIZATION TRANSMITTER

**SeedMaster 2** breaks with the tradition of using substitutes of questionable value instead of the real thing: supersaturation in crystallization control. Supersaturation is calculated on-line taking into account all of the parameters (even changing mother liquor purity as crystal content increases), which govern it (see the equation above).

SeedMaster 2 inputs:

In order to be able to do so three on-line data inputs (the first two are obligatory) and occasional laboratory data are required:

- C syrup / mother liquor concentration [%]
- T temperature [°C]
- D massecuite density, OR
- S massecuite solids content, OR
- M stirrer motor power, or current consumption, OR
- CR crystal content [%] (laboratory)
- L massecuite level [%] (optional)

The use of D, S, or M is advised.

On-line data input sources:

Obligatory:

- C syrup / mother liquor concentration [%]  
K-PATENTS process refractometers, type PR-01-S or PR-23-GP
- T temperature  
K-PATENTS process refractometers, type PR-01-S or PR-23-GP  
or third party transmitter

Selectable:

- D massecuite density  
Third party nuclear, or microwave transmitter
- S massecuite solids content  
Third party nuclear, or microwave transmitter
- M stirrer motor power, or current consumption  
Third party transmitter

SeedMaster 2 outputs:

Calculated data:

Based on the input data the SeedMaster 2 software calculates 7 massecuite parameters per pan in real time. These are:

1. SUPERSATURATION [-]
2. MASSECUITE DENSITY [kg / m<sup>3</sup>]
3. MASSECUITE SOLIDS CONTENT [%]
4. CRYSTAL CONTENT [%]
5. CONSISTENCY [%]
6. MOTHER LIQUOR PURITY [%]
7. MEAN CRYSTAL SIZE [mm]

Additional outputs:

If the K-PATENTS refractometer(s), or third party transmitter(s) are directly connected to the SeedMaster 2, their data are available as outputs, too. These possible outputs are:

8. MOTHER LIQUOR CONCENTRATION [%]
9. TEMPERATURE [°C]
10. MOTOR CONSUMPTION [kW, or A]
11. MASSECUITE LEVEL [%] (option)

**1. Any 2 of the 11 outputs listed above can be transmitted as standard current (4-20 mA) output (per pan).**

**2. All of the listed data can be transmitted by digital communication to a Process Control System or computer by using the Ethernet.**

**With these unprecedented features and the automatic seeding capability SeedMaster 2 represents a totally new kind of instrument in sugar crystallization control.**

## SeedMaster 2 THE AUTOMATIC SEEDING DEVICE

**Seeding methods.**

Seeding is a very important step in the process of crystallization, which has a large influence on the quality of the product. When completed, the crystals begin to grow in size if supersaturation is larger than 1,0.

Shock seeding is the traditional way of seeding. It relies on maintaining high supersaturation in the solution, when a small amount of seed crystals entered into the pan results in the formation of new crystals. The number of these crystals keeps growing as long as the value of supersaturation is above a "safe" (nucleation-free) limit.

The final number depends on the actual value of supersaturation, and on the time (time of nucleation) spent in the region of high supersaturation above the "safe" limit. There are at least 3 important parameters in this method of seeding:

1. the actual value of supersaturation maintained in the "seeding point" and during nucleation;
2. the length of nucleation;
3. the limit value of supersaturation above which nucleation begins, if there are already crystals in the solution.

Full seeding is the advanced mode of seeding. In ideal case there are no new crystals formed during seeding: the full required crystal crop is supplied during seeding in the form of well prepared slurry. It is assumed that only crystal growth and no nucleation will take place during the complete length of crystallization (during a strike in batch pans), that is the number of crystals in the end product is in ideal case equal to the one of the seeding material.

Besides using slurry, full seeding can be implemented by using the right amount of crystal footing (magma), too. In case of full seeding and during the complete crystallization supersaturation must not exceed its limit value. This requirement may result in somewhat longer times of crystallization than accustomed, but will result in better sugar quality.

The use of slurry (or crystal footing) alone is no guarantee for correct full seeding. Besides the right amount of slurry or footing (with the right number of crystals in it) supersaturation must not exceed its limit value. In both cases of seeding the knowledge of supersaturation is a basic requirement.

### Automatic seeding by using the SeedMaster 2

The SeedMaster 2 has 2 (DO1, DO2) digital (ON / OFF) outputs (per pan) which can be used to implement **reliable and repeatable automatic seeding** of the vacuum pans. Automatic seeding can be based on

- supersaturation or
- density

set-point (supersaturation is advised).

DO1 can be programmed to warn the operator on approaching seeding, while DO2 can be used to open the seeding valve for a configurable time interval, when the selected set-point for seeding is reached.

Besides automatic seeding manual seeding by the local operator, and seeding commanded via digital communication by a Process Control System can be carried out, too.

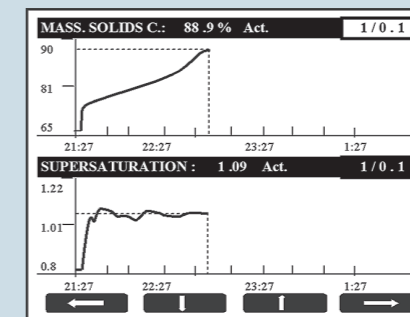
## SeedMaster 2 THE LOCAL OPERATORS' STATION

The SeedMaster 2 has very advanced local Operators' Station features. Besides having the tools for customizing the device to local circumstances and preferences (Set Up and Configure), it has a large number of well-designed, combined (character and graphic) LCD data display screens (Display), including a data archive and basic strike history data for the last 4 strikes. These can be used to study crystallization details and to improve control strategy.

SEED	MAIN	DISPLAY	1 / 0 . 1
SEED: SUPS	=1.12	AUT	STRT: 141M BU
SUPS.	1.14	LL. PUR.	92.2 %
DENS.	1481	kg/m <sup>3</sup>	LI. CONC. 81.2 %
MA. SOL.	88.7 %	MO. CONS.	36.4 A
CR. CT.	41.3 %	TEMP.	69.8 C
CONSIST.	78.2 %	LEVEL	77.5 %
WARNSD	MAIN	DISPLAY	2 / 0 . 2
SEED: SUPS	=1.12	AUT	STRT: 21M SC
SUPS.	1.05	LL. PUR.	95.2 %
DENS.	1401	kg/m <sup>3</sup>	LI. CONC. 81.2 %
MA. SOL.	81.2 %	MO. CONS.	36.4 A
CR. CT.	0.0 %	TEMP.	69.8 C
CONSIST.	28.2 %	LEVEL	37.5 %

MAIN DISPLAY

7 massecuite parameters and up to 4 measured real-time data per pan. Strike status information for both pans.



TREND DISPLAY

Any 2 out of the 7 calculated and up to 4 measured data can be trended for the actual and 3 previous strikes for both pans. Trend zooming.

WARNSD	STANDARD DISPLAY	1 / 0 . 1
SUPERSATURATION :	0.81	MASS. SOLIDS C.: % 72.8
SEED	STANDARD DISPLAY	2 / 0 . 2
SUPERSATURATION :	1.12	MASS. DENSITY: kg/m <sup>3</sup> 1482

STANDARD DISPLAY

Large-character display of 2 selected massecuite parameters per pan. Strike status information.